State of New Jersey

REPORT
COMMISSIONER
OF
PUBLIC ROADS
1898

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(Revised June 16, 1915.)

London Bridge Road, Burlington, N. J., Burlington Co. Before.

London Bridge Road, Burlington, N. J., Burlington Co. After.

FIFTH ANNUAL REPORT

OF THE

Commissioner of Public Roads

FOR THE YEAR ENDING OCTOBER 31st,

1898.

TRENTON, N. J.:
THE J. L. MURPHY PUB. CO., PRINTERS.
1898

OFFICE OF COMMISSIONER OF PUBLIC ROADS,
TRENTON, N. J., November 30th, 1898.

To the Governor and Legislature of New Jersey:

Pursuant to the requirements of the State Aid law, I herewith submit the Fifth Annual Report of the Commissioner of Public Roads for the fiscal year ending October 31st, 1898, with such comments, quotations and suggestions as existing circumstances seem to require.

HENRY I. BUDD,
Commissioner of Public Roads.

REPORT.

In compliance with the act of June 15th, 1895, we make the following statement of cost of roads.

They will claim a share of this year's State appropriation, as indicated by the figures below:

COST OF ROADS.

ATLANTIC COUNTY.

Egg Harbor City and Mays Landing road		6.84 miles.
Cost	$11,241 73	
State's share	3,747 24½	
Total paid the County		$3,747 24½

BURLINGTON COUNTY.

Columbus and Chambers Corner road		3.71/100 miles.
Cost	$16,772 35	
State's share	5,590 78⅓	
London Bridge road		¾ mile.
Cost	$4,346.06	
State's share	1,448 68⅔	
Riverton and Riverside road		3 1/10 miles.
Cost	$16,095 29	
State's share	5,365 09⅔	
Pemberton and Lisbon road		4 miles.
Cost	$12,986 31	
State's share	4,328 77	
Brown's Mill and Lisbon road		3 miles.
Cost	$8,692 92	
State's share	2,897 64	
Total paid the County		$19,630 97⅔

CAMDEN COUNTY.

Kaighn's avenue		1 67/100 miles.
Cost	$10,197 23	
State's share	3,399 07⅔	
Waterford road		11 3/10 miles.
Cost	$18,687 96	
State's share	6,229 32	
Total paid the County		$9,628 39⅔

ESSEX COUNTY.

Grove avenue		$1\frac{85}{100}$ miles.
Cost	$9,875 52	
State's share	3,291 84	
Grove street		$2\frac{58}{100}$ miles.
Cost	$14,501 57	
State's share	4,833 85⅔	
Walnut street		$1\frac{28}{100}$ miles.
Cost	$6,141 12	
State's share	2,047 04	
Franklin avenue		$\frac{1}{10}$ of mile.
Cost	$663 75	
State's share	221 25	
South Orange avenue		$3\frac{41}{100}$ miles.
Cost	$8,383 80	
State's share	2,794 60	
Total paid the County		$13,188 58⅔

GLOUCESTER COUNTY.

Asbury road		$7\frac{59}{100}$ miles.
Cost	$30,307 42	
State's share	10,102 47⅓	
Total paid the County		$10,102 47⅓

MERCER COUNTY.

White Horse road		$2\frac{99}{352}$ miles.
Cost	$18,127 99	
State's share	6,042 66⅓	
White Horse road extension		2,313 feet.
Cost	$2,553 96	
State's share	851 32	
Total paid the County		$6,893 98⅓

MIDDLESEX COUNTY.

Colonia road		$1\frac{858}{5280}$ miles.
Cost	$7,650 00	
State's share	2,550 00	
Metuchen and Menlo Park road		$2\frac{447}{2640}$ miles.
Cost	$9,400 00	
State's share	3,133 33⅓	
Menlo Park and Iselin extension		$1\frac{987}{5280}$ miles.
Cost	$4,995 00	
State's share	1,665 00	
Middlesex avenue extension		$1\frac{847}{5280}$ miles.
Cost	$4,900 00	
State's share	1,633 33⅓	
Total paid the County		$8,981 66⅔

MONMOUTH COUNTY.

Perrineville road		$3\frac{61}{100}$ miles.
Cost	$8,270 09	
State's share	2,756 69⅔	
Baird road		$1\frac{221}{280}$ miles.
Cost	$2,902 06	
State's share	967 35⅓	
Total paid the County		$3,724 05

MORRIS COUNTY.

Ridgedale avenue		$1\frac{117}{160}$ miles.
Cost	$6,050 59	
State's share	2,016 86⅓	
Basking Ridge road		4¾ miles.
Cost	$19,351 75	
State's share	6,450 58⅓	
Total paid the County		$8,467 44⅔

PASSAIC COUNTY.

Ramapo avenue		2,414 feet.
Cost	$1,139 14	
State's share	379 71⅓	
Paterson and Hamburg turnpike		3⅔ miles.
Cost	$15,426 84	
State's share	5,142 28	
Lafayette avenue		$1\frac{61}{264}$ miles.
Cost	$2,728 80	
State's share	909 60	
Fifth avenue		632 feet.
Cost	$407 00	
State's share	135 66⅔	
Total paid the County		$6,567 26

SOMERSET COUNTY.

South Somerville road		2.9 miles.
Cost	$10,951 86	
State's share	3,650 62	
Harlingen road		4.36 miles.
Cost	$16,251 89	
State's share	5,417 29⅔	
Total paid the County		$9,067 91⅔
Number of miles built	84½+	
Total cost to the State	$100,000 00	
Appropriation	100,000 00	

Total cost of roads to both State and county is given further on in the more detailed statements of engineers and supervisors.

Specifications for the following roads have been and are being prepared, some of which are under and are being placed under contract for construction under the State appropriation for the fiscal year beginning November 1st, 1898, and ending October 31st, 1899:

ATLANTIC COUNTY.

	Miles.	Est. Cost.
Mays Landing and Pleasantville road—gravel	12	$12,000 00

BURLINGTON COUNTY.

	Miles.	Est. Cost.
Farnsworth avenue and Park street	1.61	$7,858 92
Bordentown and Crosswicks creek	2	8,000 00
Burlington and Mount Holly	6	24,000 00
New Gretna and Mullica river—gravel	2½	4,500 00
Total	11⅝⅝	$44,358 92

CAMDEN COUNTY.

	Miles.	Est. Cost
River road, Pensauken creek to Camden	5	$25,000 00
Jordantown and Merchantville	1¾	7,000 00
Massy avenue, Collingswood	⅝⅛	1,042 00
Total	6⅞⅛	$33,042 00

ESSEX COUNTY.

	Miles.	Est. Cost.
Broad street, Bloomfield	2½	$10,000 00
Bay Lane	½	2,000 00
North and South Midway	7	28,000 00
Total	10	$40,000 00

GLOUCESTER COUNTY.

	Miles.	Est. Cost.
Woodbury road	⅘	$8,450 00
Clayton and Cumberland county line—gravel	6	6,600 00
Total	6⅘	$15,050 00

MERCER COUNTY.

	Miles.	Est. Cost.
Trenton and Pennington turnpike	7	$31,661 87
Asylum road	2	8,000 00
Total	9	$39,661 87

MIDDLESEX COUNTY.

	Miles.	Est. Cost.
Cranbury turnpike to Black Horse tavern	5	$21,150 00
Cranbury and Cranbury station	2	8,000 00
Total	7	$29,150 00

MONMOUTH COUNTY.

	Miles.	Est. Cost.
Navesink road—gravel	1¾	$2,925 00
Sweetman's lane and Tennent station—gravel	5½	10,044 00
Total	7¼	$12,969 00

MORRIS COUNTY.

	Miles.	Est. Cost.
Afton and Passaic river	2 15/100	$10,303 00
Succasunna	81/100	4,130 00
Millington and Passaic river	4	20,000 00
Total	6 34/100	$34,433 00

PASSAIC COUNTY.

	Miles.	Est. Cost.
Union avenue	2	$5,820 00
Midvale road	4	18,175 00
Great Notch road	1½	7,550 00
Total	7½	$31,545 00

SOMERSET COUNTY.

	Miles.	Est. Cost.
Mine Brook road	6⅖	$29,777 44

UNION COUNTY.

	Miles.	Est. Cost.
New Providence and Passaic river	3	$12,000 00
Total number of miles	94 557/800	
Total estimated cost		$333,987 23

NAMES AND LENGTHS OF THE ROADS BUILT IN 1898.

ATLANTIC COUNTY.

Egg Harbor City and Mays Landing road	6 84/100 miles.

BURLINGTON COUNTY.

Columbus and Chambers Corner road	3 71/88 miles.
London Bridge road	¾ "
Riverton and Riverside road	3 4/10 "
Pemberton and Lisbon road	4 "
Brown's Mill and Lisbon road	3 "

CAMDEN COUNTY.

Kaighn's avenue	1 67/100 miles.
Waterford road	11 8/10 "

ESSEX COUNTY.

Grove avenue	$1\frac{85}{100}$ miles.
Grove street	$2\frac{58}{100}$ "
Walnut street	$1\frac{28}{100}$ "
Franklin avenue	$\frac{1}{10}$ "
South Orange avenue	$3\frac{41}{100}$ "

GLOUCESTER COUNTY.

Asbury road	$7\frac{59}{100}$ miles.

MERCER COUNTY.

White Horse road	$2\frac{98}{163}$ miles.
White Horse road extension	2,313 feet

MIDDLESEX COUNTY.

Colonia road	1 mile, 3,861 feet.
Metuchen and Menlo Park road	$2\frac{47}{164}$ miles.
Menlo Park and Iselin extension	1 mile, 987 feet.
Middlesex avenue extension	1 mile, 347 feet.

MONMOUTH COUNTY.

Perrineville road	$3\frac{61}{100}$ miles.
Baird road	1 mile, 2,591 feet.

MORRIS COUNTY.

Ridgedale avenues	$1\frac{117}{160}$ miles.
Basking Ridge road	$4\frac{3}{4}$ "

PASSAIC COUNTY.

Ramapo avenue	2,414 feet.
Paterson and Hamburg turnpike	$3\frac{3}{4}$ miles.
Lafayette avenue	$1\frac{61}{164}$ miles.
Fifth avenue	632 feet.

SOMERSET COUNTY.

South Somerville road	$2\frac{9}{10}$ miles.
Harlingen road	$4\frac{86}{100}$ miles.
Total	$84\frac{1}{2}+$ miles.

During the years 1893 and 1894 there was built in

Middlesex County	16.09 miles.
Mercer County	12.78 "
Camden County	14.50 "
Burlington County	31.47 "
Total number of miles built in 1893 and 1894	74.76

During the year 1895 there was built in

Burlington County	9¾	miles.
Camden County	8¼	"
Essex County	6½	"
Gloucester County	7¾	"
Middlesex County	7⅝	"
Mercer County	6⅖	"
Total number of miles built in 1895	46 11/40	

During the year 1896 there was built in

Atlantic County	12	miles.
Burlington County	11 1/10	"
Essex County	6	"
Gloucester County	6	"
Mercer County	10 1/10	"
Middlesex County	9	"
Monmouth County	3¾	"
Salem County	2⅔	"
Total number of miles built in 1896	51 13/40	

During the year 1897 there was built in

Atlantic County	10½	miles.
Burlington County	10	"
Camden County	4⅛	"
Essex County	5	"
Gloucester County	5½	"
Mercer County	4¾	"
Middlesex County	4¾	"
Morris County	6⅛	"
Monmouth County	5	"
Passaic County	4¾	"
Somerset County	6⅕	"
Total	66½+	"

During the year 1898 there was built in

Atlantic County	6⅘	miles.
Burlington County	14 10/11	"
Camden County	12⅘	"
Essex County	9⅗	"
Gloucester County	7⅞	"
Mercer County	2 7/10	"
Middlesex County	6⅙	"
Monmouth County	5⅕	"
Morris County	6 1/10	"
Passaic County	5⅞	"
Somerset County	7¼	"
Total	84½+	"

The total amount expended by the State and the number of miles built in each county since the passage of the State Aid law are as follows:

County.	Miles.	Amount.
Atlantic	$29\frac{8}{10}$	$13,251 57$\frac{1}{2}$
Burlington	$76\frac{6}{44}$	134,697 31$\frac{3}{4}$
Camden	$39\frac{4}{5}$	73,405 86
Essex	$26\frac{3}{8}$	49,657 38$\frac{3}{4}$
Gloucester	$26\frac{17}{20}$	42,475 27$\frac{1}{8}$
Mercer	$30\frac{7}{10}$	104,726 98$\frac{1}{8}$
Middlesex	$43\frac{1}{6}$	79,516 46$\frac{5}{8}$
Morris	$12\frac{9}{40}$	15,524 53$\frac{3}{4}$
Monmouth	$13\frac{31}{36}$	17,655 50
Passaic	$10\frac{5}{8}$	15,299 41
Salem	$2\frac{2}{3}$	1,635 66
Somerset	$13\frac{1}{2}$	17,980 08$\frac{3}{4}$
Total	$325\frac{449}{990}$	$565,826 05$\frac{1}{2}$
Total amount appropriated by the State		$645,000 00

AMOUNT AVAILABLE FOR ROAD-BUILDING IN EACH COUNTY.

Under the State Aid law the estimated cost of all improvements made under this act, together with the estimated cost of repairs of roads already constructed in any county in any one year, shall not exceed one-fourth of one per centum of the ratables of such county for the last preceding year.

The following table will show at a glance the limitations of expenditures in each county, also the amount that can be expended, provided the State appropriation is liberal enough to meet it. For example: Atlantic county with ratables amounting to $17,605,549, could expend per year, if State appropriation were sufficient, $44,013.87$\frac{1}{2}$ of its own money, and $22,006.93$\frac{5}{8}$ of the State's money—altogether $66,020.80$\frac{7}{8}$; a rate, if applied to all the counties, even with the cost of repairs to roads already built deducted, would in a few years, cover all our leading roads with stone and gravel.

County.	Abstract of Ratables for 1897.	One-fourth of One Per Cent.
Atlantic	$17,605,549 00	$44,013 87½
Bergen	25,325,603 00	63,314 00¾
Burlington	22,776,879 00	56,942 19¾
Camden	37,159,149 00	92,897 87½
Cape May	6,282,203 00	15,705 50¾
Cumberland	16,955,677 00	42,389 19¼
Essex	192,162,000 00	480,405 00
Gloucester	14,341,546 00	35,853 86½
Hudson	156,174,239 00	390,435 59¾
Hunterdon	18,013,291 00	45,033 22¾
Mercer	43,493,872 00	108,734 68
Middlesex	27,577,303 00	68,943 25¾
Monmouth	45,691,327 00	114,228 31¾
Morris	26,370,384 00	65,925 96
Ocean	6,381,676 00	15,954 19
Passaic	57,073,571 00	142,683 92¾
Salem	14,071,293 00	35,178 23½
Somerset	17,812,700 00	44,531 75
Sussex	10,631,732 00	26,579 33
Union	37,975,600 00	94,939 00
Warren	18,733,496 00	46,833 74

The following roads have been and are being petitioned for to be improved under the State Aid act:

ATLANTIC COUNTY.

Mays Landing and Pleasantville road, gravel, 12 miles; estimated cost, $12,000.

Atlantic City and Longport road, gravel, 6 miles; estimated cost, $12,000.

Mays Landing and Tuckahoe road, gravel, 11 miles; estimated cost, $11,000.

Total number of miles, 29; total estimated cost, $35,000.

BURLINGTON COUNTY.

Moorestown and Marlton road, stone, 4⅝ miles; estimated cost, $16,000.

Masonville and Coates Corner road, stone, 3.50 miles; estimated cost, $14,000.

Cross Roads and Green Tree, stone, 2.50 miles; estimated cost, $10,000.

Green Tree Pike, stone, 2 miles; estimated cost, $8,000.

Medford and Fairview road, stone, 1.50 miles; estimated cost, $6,000.

Fairview and Indian Mills road, gravel, 7 miles; estimated cost, $8,400.

Medford and Tabernacle road, stone, 8 miles; estimated cost, $40,000.

Indian Mills, Atsion and Batsto road, gravel, 9.50 miles; estimated cost, $19,000.

Pemberton and Wrightstown road, stone, 6 miles; estimated cost, $24,000.

Columbus, Burlington and Bowne's Corner road, stone, 10 miles; estimated cost, $40,000.

Burlington and Jacksonville road, stone, 6 miles; estimated cost, $24,000.

Mount Holly and Jacksonville road, stone, 4 miles; estimated cost, $20,000.

Burlington and Mount Holly road, stone, 6 miles; estimated cost, $24,000.

Rancocas and Burlington road, stone, 4 miles; estimated cost, $16,000.

Charleston and Burlington road, gravel, 3 miles; estimated cost, $6,000.

Rancocas and Beverly road, stone, 5 miles; estimated cost, $20,000.

Crosswicks Creek and Bordentown road, stone, 2 miles; estimated cost, $8,000.

Medford and Wilkins Station road, stone, 1.50 miles; estimated cost, $6,000.

From Wrightstown to Rising Sun Square, stone, 7 miles; estimated cost, $24,500.

Keeler's Corner and Jacksonville road, stone, 2 miles; estimated cost, $8,000.

Intersection of Wading River road to Mullica river, gravel, 1.75 miles; estimated cost, $3,500.

New Gretna to Mullica river, gravel, 2.25 miles; estimated cost, $4,500.

Bordentown and Crosswicks Creek road, stone, 2 miles; estimated cost, $8,000.

Tabernacle to Chatsworth, gravel, 10.50 miles; estimated cost, $21,000.

Hartford to Bridgeboro road, stone, 3.3 miles; estimated cost, $13,200.

Mount Holly and Smithville road, stone, 2 miles; estimated cost, $8,000.

Total number of miles, $116\frac{37}{40}$; total estimated cost, $400,100.

CAMDEN COUNTY.

River road, Pensauken creek to Camden, stone, 5 miles; estimated cost, $25,000.

Jordantown road, stone, 1.75 miles; estimated cost, $7,000.

Massy avenue, Collingswood, stone, 1,100 feet long; estimated cost, $1,042.

Heading and Lawnside road, stone, 2.50 miles; estimated cost, $12,000.

Sickletown to Chew's Landing, gravel, 8 miles; estimated cost, $9,600.

Total number of miles, $17\frac{121}{264}$; total estimated cost, $54,642.

ESSEX COUNTY.

Broad street, Bloomfield, stone, 2.50 miles; estimated cost, $10,000.

Bay lane, Bloomfield, stone, $\frac{1}{2}$ mile; estimated cost, $2,000.

North and South midway, stone, 7 miles; estimated cost, $28,000.

Mount Hebron road, Montclair, stone, 1 mile; estimated cost, $4,000.

Mountain road, stone, 3.20 miles; estimated cost, $12,800.

Eagle Rock road, stone, 1 mile; estimated cost, $4,000.

Bloomfield avenue, stone, 1.75 miles; estimated cost, $7,000.

Fairfield road, stone, 3.80 miles; estimated cost, $15,200.

Roseland avenue, stone, .75 mile; estimated cost, $3,000.

Total number of miles, 21.50; total estimated cost, $86,000.

GLOUCESTER COUNTY.

Woodbury to Knight's Run school-house, gravel, 5.26 miles; estimated cost, $7,890.

Clayton and Cumberland county line road, gravel, 6 miles; estimated cost, $6,600.

Main street, Woodbury, stone, 4,200 feet long; estimated cost, $8,450.

Nortonville bridge to Swedesboro stone road, stone, 6 miles; estimated cost, $24,000.

Total number of miles, $18\frac{61}{100}$; total estimated cost, $46,940.

MERCER COUNTY.

Trenton and Pennington road, stone, 7 miles; estimated cost, $31,661.87.

Trenton, Asylum and Birmingham road, stone, 4 miles; estimated cost, $16,000.

Upper Ferry road extension, stone, 2 miles; estimated cost, $8,000.

Whitehead's and Hutchinson road, stone, 2 miles; estimated cost, $8,000.

Shabbakong road, stone, 3 miles; estimated cost, $13,500.

Hightstown and York road, stone, 3.25 miles; estimated cost, $14,625.

Allentown turnpike, stone, 3.45 miles; estimated cost, $15,525.

White Horse and Yardville road, stone, 2 miles; estimated cost, $9,000.

Total number of miles, 26.7; total estimated cost, $116,311.87.

MIDDLESEX COUNTY.

Carteret to Rahway line, stone, 1.6 miles; estimated cost, $8,000.

Cranbury and Cranbury Station road, stone, 2 miles; estimated cost, $8,000.

Cranbury turnpike, from New Brunswick to Black Horse, stone, 4.7 miles; estimated cost, $21,150.

South Amboy and Sayreville road, stone, 6.5 miles; estimated cost, $32,500.

Dunellen and Bound Brook road, stone, 3.2 miles; estimated cost, $14,400.

Highland Park and Bonhamton road, stone, 4 miles long; estimated cost, $18,000.

South Plainfield and Plainfield road, stone, 1.60 miles; estimated cost, $6,500.

New Brooklyn and Mount Pleasant road, stone, 1.25 miles; estimated cost, $5,000.

River road, New Brunswick to Bound Brook, stone, 4 miles; estimated cost, $16,000.

Carteret and Rahway Avenue road, stone, 1.60 miles; estimated cost, $7,200.

New Brunswick and Franklin Park road, stone, 5.50 miles; estimated cost, $16,500.

Spotswood and Englishtown road, gravel, 2.50 miles; estimated cost, $3,000.

Clifton avenue and Ryder's Lane road, stone, 3.20 miles; estimated cost, $14,400.

Total number of miles, 41.15; total estimated cost, $170,150.

MONMOUTH COUNTY.

Atlantic Highlands and Navesink Bridge road, gravel, 3.50 miles; estimated cost, $7,000.

First avenue, Atlantic Highlands, to Navesink, gravel, 1 mile; estimated cost, $2,000.

Sweetman's lane to Tennant station, gravel, 5.58 miles; estimated cost, $10,044.

Lower Squankum road, gravel, 7.73 miles; estimated cost $13,914.

Asbury Park road, stone, 1.50 miles; estimated cost, $7,500.

Stone Church and Maxon's Hill road, gravel, $1\frac{5}{8}$ miles; estimated cost, $2,925.

Total number of miles, $20\frac{187}{200}$; total estimated cost, $43,383.

MORRIS COUNTY.

Williams Corner and Townley Bridge road, stone, 2.05 miles; estimated cost, $10,528.

Whippany and Parsippany road, stone, 3.79 miles; estimated cost, $20,044.

Succasunna road, stone, .81 mile; estimated cost, $4,130.

Afton and Hanover road, stone, 2.15 miles long; estimated cost, $10,303.

Netcong and Budd's Lake road, stone, 4.59 miles; estimated cost, $17,475.

Long Hill and Gillette road, stone, 2 miles; estimated cost, $13,212.

Chester to D., L. & W. R. R. station, stone, .96 miles; estimated cost, $4,915.

New Vernon road, stone, 2 miles; estimated cost, $10,400.

Denville and Pine Brook road, stone, 7.27 miles; estimated cost, $39,560.

Williams Corner and Passaic River road, stone, 3.15 miles; estimated cost, $16,065.

Morristown and Mount Freedom road, stone, 5 miles; estimated cost, $26,500.

Rockaway road, stone, .89 mile; estimated cost, $6,078.

Mendham to Somerset county line, stone, 2.40 miles; estimated cost, $13,073.

Millington and Passaic river road, stone, 4 miles; estimated cost, $20,000.

Total number of miles, 41.06; total estimated cost, $212,283.

OCEAN COUNTY.

Long Beach road, gravel, 20 miles; estimated cost, $40,000.

Total number of miles, 20; total estimated cost, $40,000.

PASSAIC COUNTY.

Union avenue road, stone, 2 miles; estimated cost, $5,820.

Mountain View and Singac road, stone, 2 miles; estimated cost, $5,800.

Tilt street and Grand Summit avenue, stone, ⅓ of a mile long; estimated cost, $970.

Midvale road, stone, 4 miles; estimated cost, $18,175.

Total number of miles, 8⅓; total estimated cost, $30,765.

SOMERSET COUNTY.

Mine Brook road, stone, $6\frac{11}{10}$ miles; estimated cost, $29,777.44.

Bernardsville and Basking Ridge road, stone, 1 mile; estimated cost, $4,000.

East Millstone and New Brunswick road, stone, 6 miles; estimated cost, $21,000.

Somerville and Raritan road, stone, 2 miles; estimated cost, $6,000.

Franklin Park and New Brunswick road, stone, 5.50 miles; estimated cost, $16,500.

Dead river and Liberty Corner road, stone, 3.50 miles; estimated cost, $12,250.

Millstone river and Rocky Hill road, stone, 1.50 miles; estimated cost, $4,500.

Plainville and Cherry Valley road, stone, 7 miles; estimated cost, $24,500.

Passaic river, Smalleytown and North Plainfield township road, stone, 3 miles; estimated cost, $10,500.

Basking Ridge and Van Doren's Mill road, stone, 3 miles; estimated cost, $12,000.

Somerville and New Jersey turnpike road, stone, 6 miles; estimated cost, $24,000.

Somerville to North Branch of Raritan river, stone, 9 miles; estimated cost, $36,000.

Labaw's Corners and Rocky Hill road, stone, 4 miles; estimated cost, $16,000.

Liberty School-house and Conover's Corners road, stone, 3 miles; estimated cost, $10,500.

Total number of miles, $61\frac{3}{25}$; total estimated cost, $227,527.44.

UNION COUNTY.

New Providence and Passaic River road, stone, 3 miles; estimated cost, $12,000.

Total number of miles, 3; total estimated cost, $12,000.

Total number of miles of roads petitioned for in all the counties, $425\frac{273}{1320}$; total estimated cost of all the roads petitioned for, $1,472,429.12.

Lodi, N. J., Bergen Co.

Four-inch Macadam Pavement carrying heavy traffic.

Union St., Lodi, N. J., Bergen Co.

Four-inch Macadam, carries a heavy brick and ice traffic—150 loads per day of 3 to 5 tons on narrow tires. W. C. Foster, Engineer.

DESCRIPTION OF ROADS IMPROVED IN 1898.

ATLANTIC COUNTY.

Egg Harbor City and Mays Landing Road, 6.75 Miles Long.

This road extends from the German city of Egg Harbor to Mays Landing, the county seat of Atlantic county. It is constructed of gravel, fourteen feet wide and eight inches thick. The gravel was mostly obtained along the line of the road.

This road passes over a sandy region, principally covered with pines and scrub-oaks, along which there are a number of clearings and settlements made by Congressman Gardner and Italians.

Upon these clearings there are being planted strawberries, raspberries, blackberries and various kinds of vegetables and fruits.

Over what was once an extremely sandy road there is now a superb highway, giving the inhabitants of Hammonton, Elwood, Egg Harbor City and numerous other settlements a free and beautiful driveway to the county seat of Mays Landing.

The maximum grade is 2.10 per cent.

The cost per cubic yard for compacted gravel in road-bed was 31 cents.

The total cost of the road was $12,319.22.

BURLINGTON COUNTY.

London Bridge Road, Three-fourths of a Mile Long.

This road begins at the city line in the city of Burlington, and runs through the city in a northeasterly direction to the Camden and Amboy railroad. It is sixteen feet wide and eight inches thick, made of stone one and a quarter to one and a half inches in size, rolled in two courses.

It connects the macadam roads leading from Burlington, through Bridgeborough to Camden, making a continuous line from the rail-

road on the main street of Burlington to the cities of Camden and Beverly, virtually a completion of the Bridgeborough and Burlington road.

It runs over a sandy surface, each side of it lined with truck farms and suburban homes.

The maximum grade is .009 per cent.

The cost per square yard was 57 cents.

The total cost was $4,522.98.

Brown's Mill and Lisbon Road, $2^{3928}/_{5280}$ *Miles Long.*

This road is a continuation of the Pemberton road, and is constructed of trap-rock ten feet wide and six inches deep. It extends partly through a farming district and partly through a pine, sandy region to the celebrated summer resort of Brown's Mills. This is a completion of an improved highway between Brown's Mills and the city of Camden; it enables loaded wagons, carriages and cyclers to travel continuously thirty miles over a hard, smooth surface to this resort. The intention is to prepare a cycling path from this point to Lakewood, the most famous winter health resort in New Jersey.

The maximum grade is $3\frac{1}{2}$ per cent.

The cost per square yard was 54 cents.

The total cost of the road was $8,996.23.

River Road, $3^{13}/_{33}$ *Miles Long.*

This road is twelve feet wide and eight inches thick. It is built of Bergen Hill trap rock. It extends from Riverton to Riverside, through a thickly-settled trucking country. The land over which it passes is a sandy loam, sand predominating, and forms a much-needed connection between the improved systems of roads east and west, and makes a macadam road along the whole length of the river from Burlington city, through Burlington county to the Camden county line. As the land bordering is fast being dotted with residences, it was thought advisable to make the grade almost level, not more than 1 per cent.

The cost per square yard was 67 cents.

The cost of the road was $16,889.39.

Pemberton and New Lisbon Road, $3^{2291}/_{5280}$ *Miles Long.*

This road extends in a northerly direction from the Rancocas creek, in the village of Pemberton, over the main street of the village to the North Pemberton railroad depot at Budd's run. At Davis' Corner the improvement commences over Hanover street and extends over the whole length of this street in an easterly direction to the county-house farm.

It runs through the beautiful village of Pemberton, and, in conjunction with the citizens, the whole street is paved from curb to curb with a six-inch trap-rock pavement. Through Hanover street the road is fourteen feet wide and six inches deep; outside of the village it is ten feet wide and six inches thick.

The road passes through a very fine agricultural district and connects the almshouse of the county with the improved system of macadam roads leading from Pemberton to Mount Holly, and thence on to the city of Philadelphia. The soil is sandy loam and black sand, noted for producing heavy crops of grass and grain. A large amount of produce passes over this road to Philadelphia and the towns and cities that line the Delaware river.

The borough of Pemberton, like most of the cities and towns through which these State road improvements have passed, adopted an ordinance to pave the balance of the street outside of the limit of the State and county aid, which action gives to Pemberton two very fine macadamized streets its whole length and width.

The maximum grade is $3\frac{1}{2}$ per cent.

The cost per square yard for macadam was 57 cents.

The cost of the road was $13,619.10.

Columbus and Chambers Corner Road $3^{71}/_{88}$ *Miles Long.*

This road extends from Columbus to the Jobstown pike, completing the chain, making a continuous improved road from Mount Holly to Columbus. It is built of macadam, ten feet wide and eight inches thick, of Lambertville Delaware river trap laid in two courses, the lower one of stone one and one-half inches in size, the upper course of one-and-one-fourth-inch size.

It passes through a fine grazing region, principally meadows, the uplands composed principally of sandy loam, covered with many productive farms. A wide area is tributary to and the road gives passage to its products to either the markets of Trenton or Philadelphia.

The maximum grade is about 5 per cent.

The cost per square yard for macadam was 74 cents.

The cost of the road was $17,577.97.

CAMDEN COUNTY.

Waterford Road, 11.12 *Miles Long.*

This road is built of gravel, fourteen feet wide and eight inches deep in the center and six inches on the side.

It begins at the end of the stone road in Berlin and runs in a southeasterly direction through the villages of Atco, Waterford, Ancora and Elm to the Atlantic county line. It passes through a sandy and pine district, interspersed here and there with truck and berry farms, cranberry bogs and sandy pine wastes. The thriving settlements along its line are like so many oases in a desert.

Considering the shortness of the gravel-supply, an uncommonly hard, smooth road has been constructed. It was with much difficulty that the proper kind of material could be obtained; many openings and strippings were made, only to find the material worthless. Resting principally upon a light, sandy bottom, the gravel makes a very pretty road for light travel most of the months of the year. Its completion makes the last link of an improved road from Camden to Atlantic City. Bicycles can now travel, at their highest rate of speed, a distance of sixty-four miles, without any interruption to their progress. Several thousand bicycles a day sometimes pass over this route. This completed roadway promises to transform a wilderness into a paradise, where a porous soil and balmy pine air enable those seeking health to settle with impunity and have quick access either by bicycle, wagon or rail to the populous cities north and the celebrated seaside resorts south.

The maximum grade is 1.80 per hundred feet.

The cost per cubic yard for compacted gravel in the roadbed was 26¾ cents.

The total cost was $19,858.81.

Kaighn's Avenue, 1.67 *Miles Long.*

This road begins at Haddon avenue and runs in an easterly direction to the Browning road, all in the city of Camden. The construction was fourteen feet wide and ten inches thick. The material was Bergen Hill trap. It gives a large area of country lying to the east a direct and shorter connection with Kaighn's avenue ferry.

The maximum grade is 2.70 feet per hundred feet.

The cost per square yard was 68 cents.

The cost of the road was $10,789.65.

ESSEX COUNTY.

Grove Street, Montclair, 2.58 *Miles Long.*

This road begins at Chestnut street, in the township of Montclair, and extends in a northerly direction to the Passaic county line. It is built of telford, sixteen feet wide and eight inches thick.

This road extends through an improved section of Montclair, fine houses being erected on each side. It passes over a stiff clay till, glacier drift, composed of gravel and red clay, on account of which the excavation was difficult. Boulders were used in the bottom of the road to form a telford foundation, on the top of which were placed three inches of macadam.

The maximum grade is 3.1 feet in 100.

The cost per square yard was 43 cents.

The total cost of the road was $14,501.57.

Franklin Avenue, Bloomfield, 528 *Feet Long.*

This road begins at the Morris canal bridge, in the township of Bloomfield, and extends in an easterly direction to Jeroloman street. It is built of telford, sixteen feet wide and eight inches thick.

It runs through a clay soil, not many boulders. It is a continuation of one of the improved streets of Bloomfield.

The maximum grade is 5.2 feet in 100.

The cost per square yard was 49 cents.

The total cost of the road was $663.75.

South Orange Avenue, 3.41 *Miles Long.*

This road is fourteen feet wide and eight inches deep. It commences at the foot of the Second Orange mountain, and runs west, over said mountain, through a rough country covered with timber and boulders. Trap boulders form the bottom course to the depth of five inches; the surface is formed of crushed trap, three inches deep. It was an expensive road to grade, on account of the deep cuts required to overcome the steep ascent. There are a few dairy farms along its line, but its principal service will be in furnishing a short route for the farmers of Passaic valley to the markets of Orange and Newark.

This road has been widened to seventy-five feet to accommodate a contemplated trolley line without interfering with the macadam bed. The city of Newark has located one of its most picturesque parks in one of the wildest sections along this line. This route is the most direct from the Oranges to Morristown, and was once used as a stage road between the two places. On account of the heavy grading the contractor has been two years in completing same.

The maximum grade is 7.83 feet per 100.

The total cost of the road was $19,210.80.

Grove Avenue, Verona, 1.85 *Miles Long.*

This road begins at Bloomfield avenue, in the township of Verona, and extends in a northerly direction to the Pompton turnpike. It is built of telford, sixteen feet wide and eight inches thick.

It runs through a sand, gravel, clay and boulder formation, resulting from the deposits of the glacier drift that covers the most of this region.

The maximum grade is 3.37 feet in 100.

The cost per square yard was 34 cents.

The cost of the road was $9,875.52.

Walnut Street, Livingston, 1.25 *Miles Long.*

This road begins at Mount Pleasant avenue, in the township of Livingston, and extends in a southerly direction to Northfield road, connecting the improved roads of this section. It is built of telford, fourteen feet wide and eight inches thick.

It runs through grazing and agricultural lands, composed of clay, sand and gravel.

Walnut St., Livingston, N. J., Essex Co. Before.

Walnut St., Livingston, N. J., Essex Co. After.

Western Essex is receiving a large amount of road improvement through the State Aid, which is bringing in close communion with the outside world a very picturesque farming country.

The maximum grade is 2.87 feet in 100.

The cost per square yard was 42 cents.

The cost of the road was $6,141.12.

GLOUCESTER COUNTY.

Asbury Road, 7.50 Miles Long.

This road extends from Paulsboro in a southwesterly direction to Swedesboro. It is built of macadam, sixteen feet wide in the village of Paulsboro, ten feet wide in the open country and eight inches thick.

The land over which it passes is an alluvial, sandy and sandy-loam country, interspersed with several tidal meadows. The roadbed was, at most seasons of the year, almost impassable to loaded teams, on account of the depth of sand. A large amount of produce is raised along this road, which needed a harder line of travel in order that it might be cheaply conveyed to the city markets.

At Swedesboro it connects with a macadam road built three years ago through the town of Swedesboro. At Paulsboro it connects with a macadam road leading from Paulsboro to Westville, which there connects with another macadam road leading to the Gloucester ferries. This road and others that have been built in Gloucester county are giving an easy outlet to the immense amount of produce that is now passing over them to the Gloucester ferries. From one to two thousand teams are daily carried over these ferries, heavily loaded with all the varied productions of this fertile region.

The maximum grade of this road is 3¾ per cent.

The cost per square yard for macadam was 64 cents.

The total cost was $31,390.56.

MERCER COUNTY.

White Horse Road, $2^{93}/_{352}$ Miles Long.

This road extends from Liberty street, in the city of Trenton, to White Horse tavern. This avenue is one hundred feet wide. The largest portion of the way the car tracks are located in the center of

the road, the remaining portion on the side. As far as the car tracks run in the center of the road, it has been paved with a four-inch macadam, forty-four feet wide, the State paying towards its construction what a sixteen-foot pavement eight inches deep would cost. The balance of the street is sixteen feet wide and six inches deep.

This road was built upon a sandy-loam bed. Both beds were carefully put down, the four-inch in two layers of three inches each, and rolled down to four inches; on the six-inch bed two layers of four inches each were spread and rolled down to six inches.

This line is a very important connection between the roads leading to the Burlington county system and the eastern and northern portions of Mercer.

The maximum grade is .0171 per cent.

The contract price was a lump sum of $17,900, but on account of underdraining, the cost was $19,002.19.

White Horse Road Extension, 2,313 *Feet Long.*

This road extends from the White Horse to Crosswicks creek, the boundary line between Burlington and Mercer counties. It connects the Burlington and Mercer county system of roads. It is built of macadam, twelve feet wide, six and eight inches deep. Both of these roads were constructed of crushed trap, 1.50 to 2.50 inches in size, from the Moore quarries on the Delaware river.

This piece of road formerly covered a very steep hill, which has been reduced to a maximum grade of .056 per cent.

The cost of the road was $3,025.49.

MIDDLESEX COUNTY.

Metuchen and Menlo Park Road, 2.18 *Miles Long.*

This road begins at the westerly line of Main street, Metuchen, and extends along the Middlesex and Essex turnpike to the dividing line between the townships of Raritan and Woodbridge.

It is built of macadam, twelve feet wide and eight inches thick.

The maximum grade is 4 per cent.

The total cost was $11,123.

New Dover Road, 1 *Mile* 3,861 *Feet Long.*

This road begins at the cross-roads in New Dover and extends in an easterly direction to Colonia railroad station and to the county line at the city limits of Rahway.

It is built of macadam, twelve feet wide and eight inches thick.

The maximum grade is 1.50 per cent.

The total cost was $8,202.

Menlo Park and Iselin Extension, 1 *Mile* 987 *Feet Long.*

This road begins at Perth Amboy avenue at Rowland's corner, Woodbridge, and extends west to Erastus Freeman's corner; also from Iselin southeast to Menlo Park, about four miles, and from Freeman's corner to Oak Tree, where it strikes the macadam road now finished.

It is built of macadam, twelve feet wide and eight inches thick.

The maximum grade is 3 per cent.

The total cost was $5,277.90.

Middlesex Avenue Extension, 1 *Mile* 347 *Feet Long.*

This road begins at the north side of road leading from Plainfield to Woodbridge near Iselin, and running northeasterly to the New Dover road.

It is built of macadam, twelve feet wide and eight inches thick.

The maximum grade is 4 per cent.

The total cost was $5,316.18.

These four roads in Middlesex county run through a good farming country, the soil being a sandy loam and red shale. They make a continuous line from Metuchen to Rahway. From Metuchen there are now macadam roads leading in every direction. They form improved ways from New Brunswick to Jersey City, from Perth Amboy to Jersey City and from Plainfield to Jersey City.

MONMOUTH COUNTY.

Perrineville Road, 3.61 *Miles Long.*

This road begins at the Perrineville post-office, and extends in a westerly direction to the Mercer county line. The construction is of bog ore and gravel, taken from local beds in the vicinity. It is twelve feet wide and six inches thick. It passes through a sandy and sandy-loam farming district, and forms an outlet towards Hightstown for the productions of this region.

The maximum grade is about 3 per cent.

The price per cubic yard, compacted gravel in the road-bed, was 27.75 cents.

The total cost was $9,000.05.

Baird Road, 1.50 *Miles Long.*

This road begins at Manalapan and extends in a westerly and southerly direction to Baird's post-office. It is constructed of gravel obtained from beds along the line of the road, and is twelve feet wide and eight inches thick.

This road passes through a fairly good farming region composed of sand and sandy loam. It forms an outlet, in connection with the Manalapan and Englishtown road, to the depot at Manalapan, where a large quantity of the produce of this region is shipped.

The maximum grade is about 3 per cent.

The cost per cubic yard, compacted gravel in the road-bed, was 63 cents.

The total cost was $3,460.26.

MORRIS COUNTY.

Basking Ridge Road, 4.75 *Miles Long.*

This road extends from All Souls Hospital, Morristown, in a southwesterly direction to Passaic river. It is built of trap-rock from the Millstone quarries, and is twelve feet wide and six inches thick. It passes through an old-settled farming district, and is part of a continuous line which is contemplated south through Bernardsville to Somerville, Somerset county, thus giving this large area of country, now being rapidly dotted with fine residences built by the citizens of New York City, a fine drive to the city of Morristown.

The maximum grade is 6 per cent.
The cost per square yard was 48 cents.
The total cost was $21,864.42.

Ridgedale Avenue, 1.548 *Miles Long.*

This road begins at the Madison borough line, in the township of Chatham, and extends in a northeasterly direction to Afton. It is part of a continuous line through a fine agricultural district, connecting the borough of Madison with the improved system of roads in Essex county. It is built of macadam, twelve feet wide and six inches thick.

The soil over which this road passes is a clay and sandy loam. It is an old and well-settled country, on which are many thrifty orchards.

The maximum grade is 4.5 per cent.
The cost per square yard was 42 cents.
The total cost was $6,553.67.

PASSAIC COUNTY.

Paterson and Hamburg Turnpike, 3⅞ *Miles Long.*

This road is a continuation of the county macadam road from the city of Paterson to the line dividing Passaic and Morris counties. It is fourteen feet wide and four inches thick.

This road passes through a wild and picturesque country to the town of Newfoundland, through a country that is largely devoted to the gathering of water for the New Jersey Water Company, which supplies the cities of Newark, Paterson and Jersey City with water. In this section there is a large summer population, being a cool refuge from the heat of New York and the surrounding cities.

The construction of this road is of native stone, principally gneiss and granite. Local crushers are placed at prominent rock projections along the road; therefore, the cost is reduced to a minimum, and is mainly for the crushing of the stone. The grading and blasting add largely to the cost of road construction in this section, there being 6,478 cubic yards of solid rock excavation, 4,300 cubic yards of loose rock, and 11,480 cubic yards of earth excavation.

The maximum grade is about 5 per cent.
The cost per square yard was 19.50 cents.
The total cost was $16,654.07.

Lafayette Avenue, $1^{61}/_{264}$ *Miles Long.*

This road begins at Wagaraw road and extends to Rea avenue; it simply makes a connection with some completed roads near the city of Paterson. It is built of macadam, sixteen feet wide and four inches thick, of local trap.

The maximum grade is 1 per cent.

The cost per square yard was 24 cents.

The total cost was $3,892.79.

Ramapo Avenue, 2,414.27 *Feet Long.*

This road begins at the Paterson and Hamburg turnpike and extends to Lakeside avenue, in the borough of Pompton Lakes. It is sixteen feet wide and four inches thick, and is built of local trap.

This road gives an outlet for a secluded portion of the borough to the main turnpike.

The maximum grade is 2 per cent.

The cost per square yard was 23.5 cents.

The total cost was $1,139.14.

Fifth Avenue, 632 25 *Feet Long.*

This road begins at Crooks avenue, near the city of Paterson, and extends seventy-five feet south of South Second street.

It is constructed of macadam, sixteen feet wide and four inches thick, and connects with one of the improved streets of the city.

The maximum grade is about 4 per cent.

The cost per square yard was 37 cents.

The total cost was $407.

SOMERSET COUNTY.

Harlingen and Belle Mead Road, 4.366 *Miles Long.*

This road begins at Princeton road, in the township of Montgomery, and extends in a northerly and westerly direction to Conover's Corners. It was constructed ten and twelve feet wide and eleven inches deep, composed of six inches of rock bottom overlaid with macadam five inches thick, the rock bottom of indurated shale, the top of local trap obtained from the mountains two miles away and prepared by crushers located at Belle Mead.

The road passes through a very heavy red shale district, the soil of which furnishes a very firm, smooth surface in summer, but a very poor foundation in winter. This is a dairy country, and teams have had much difficulty during the bad seasons of winter in reaching the dairy that is located at Belle Mead. This road gives a pleasant outlet for the farmers of the surrounding country to the stations of Harlingen and Belle Mead, located along the line of the Bound Brook railroad.

The maximum grade is 4.82 per cent.

The price per square yard for ten-inch rock and macadam, 52 cents; pure macadam, 56 cents.

The total cost was $16,591.84.

South Somerville Road, 2.9 *Miles Long.*

This road begins at the track of the Central Railroad of New Jersey at South Somerville and extends in a southerly direction to the bridge over Royce's branch. It is twelve feet wide and eleven inches thick. It is built of rock foundation, six inches thick, and macadam on top, five inches thick.

This road passes through a red shale country, in which are fine farms, and is intended to be connected with the Harlingen road.

The maximum grade is 5.34 per cent.

The price per square yard for eight-inch macadam was 48 cents; price per square yard for rock and macadam, 54 cents.

The total cost was $11,761.21.

Kaighn's Ave. Extension, Camden Co., N. J. Before.

Kaighn's Ave. Extension, Camden Co., N. J. After.

THE PROGRESS OF ROAD-BUILDING IN OUR STATE FOR THE YEAR 1898.

MANNER OF CONSTRUCTION.

During the year 1898 the State aid has been spread over about eighty-five miles of roads. This is an extension of the bounty over a larger area than any previous year. The construction in 1895 was about forty-six miles; in 1896, about fifty miles; in 1897, about seventy miles, and in 1898, about eighty-five miles. The ability to construct a greater number of miles each year arises from a better understanding, on the part of the State and counties, of the principles of road-building. It has been the rule in the past to insist it was necessary to first lay an expensive foundation of large stones; consequently, the largest part of the cost of the roads was in the foundations. Observation and experience have demonstrated that the earth, properly drained, is as good a foundation as can be obtained for any road superstructure, and therefore it is not necessary to deposit any more thickness of metal upon the surface than is required to stand up under the wear until the roads have to be resurfaced. After the roads are subjected to two or three inches of wear, it seems necessary, in order to preserve a proper surface, to recoat the road; so all that is needed to maintain the integrity of the road is to have a sufficient foundation to sustain these two or three inches. Therefore the principal construction of the State has been resolved into roads four, six and eight inches deep. In Essex and other localities where there are great quantities of stones lying around loose in the fields, alongside of the roads and in the stone fences, the large stones are cheaply turned into the bottom, forming a telford foundation upon which a base of three or four inches of cracked stone is placed, these roads not costing any more where these boulders abound than those where the broken stone requires long transportation.

The result of it all has been that stone roads in Burlington and other counties have usurped the lines where gravel was intended, because, upon calculation, it has been found that the stone can be supplied and placed almost as cheaply as the gravel, and cheaper where the gravel has to be carted long distances, the cost of maintaining being much less and the stability of the roads much greater, they not being weakened by the changes of seasons. The gravel roads are not firm on any soil but sand during the winter and wet periods, while the stone roads are at their best in those seasons when most needed by the farmers to cart their produce to market.

MAINTAINING THE SURFACE.

We are also learning to cheaply maintain the surface of these roads. We have discovered that the application of coarse sand, or gravel and loam, in which there is oxide of iron, will maintain the integrity of the surface by keeping the wear of the wagons and horses' shoes from the stone, and making a soft cushion for their feet. These coatings also prevent the powder that binds the stone from blowing away, and keeps the necessary amount of moisture beneath to maintain the cementation qualities of trap stone dust, which, when moist, is a most powerful agent in binding broken stone together. When dry, it relaxes its hold and then the picking of the toes of the horses' shoes sometimes loosens the stone and causes what is termed raveling. In my visit to Long Island we found many miles of stone roads covered with sand from one-half to one inch deep. We noticed in traveling over the country that where this practice prevailed the roads were in fine condition. We persuaded the Overseers, Supervisors and Freeholders in different parts of our State to apply sand; the application has produced a very handsome effect. Loamy gravel is also used with very good results. So we are learning by utilizing the materials that lie along or near the lines of the roadbeds to support the heavy traffic and to preserve the surface from wear at a very small expense.

GRAVEL ROADS.

Monmouth and Atlantic counties seem to prefer gravel roads, because of the abundance and close proximity of gravel beds to the contemplated improvements; so the majority of construction in these

counties is of that material. These form, upon the sand on which they are principally built, very creditable roads, seeming to well serve the purpose of these districts; but if the traffic on these highways were heavy, the gravel would not answer the purpose. They are mostly built through thinly-settled sections, generally connecting populous centers.

DESIRE FOR IMPROVED ROADS.

There is a rapidly-growing demand nearly all over the State for the macadamizing of roads, especially in those counties where this form of improvement has been started. There are now fourteen counties that have heartily entered into the contest, having already petitioned for future construction of over 400 miles, and four more would gladly embrace the opportunity of receiving State aid if their governing bodies would only take note of individual petitions.

INCREASED APPROPRIATIONS.

On the other hand there does not seem to be any necessity for stimulating this desire unless the State appropriation is increased, for there is not enough money now available from present annual donation to build one-fifth of the roads that are being applied for in the counties most enthusiastic for their construction. If the appropriation is to remain at the present figure, we would like to see the construction confined to the counties now earnestly building, so that their leading lines might be speedily completed. By concentration in these counties, we would be able to quickly complete lines already started. By spreading the construction over all the counties, we are only able to build a few miles, an infinitesimal amount in each county, and thus the full breadth and measure of the work is not soon enough obtained. By concentration we can soon complete leading lines by connecting all portions of their counties with the great towns and cities.

After having completed the work in these, we could take it up in the less progressive counties; pursuing the same policy with them, when they become ripe, would in turn give them a useful and comprehensive system. With a larger donation from the State, say three hundred thousand dollars, we would be able, with the seven hundred thousand added by individuals and counties, to quickly complete the

work in the progressive counties; they would then be out of the race, and those that have been later in embracing the bounty could receive the full amount of the same, and thus be enabled to rapidly construct a thorough and well-planned system of roads. It is impossible to carry out the full intent of the law if each county only receives a few miles each year. We believe that when the leading lines in each of the counties shall have been completed, these will largely cease to be petitioners for the State bounty, as they then will have enough miles of roads to keep in repair to consume the amount for which the people will consent to be taxed, and to pay the principal and interest of the bonds that are being issued in some counties to meet the State road appropriation. These counties will never cease to demand a large share of the State appropriation until their lines, leading toward our great cities and important towns, are constructed. The popularity and stimulus of State aid is so great in many portions of our State that a candidate could not be elected to a State office if he were to announce his antagonism to the same. The use of those roads already finished is creating such a desire for more that many counties are building, without State aid, stone and gravel ways to connect with the great State stone thoroughfares. In one county alone this year eighteen miles were built, besides all it was entitled to under State aid; another county built ten miles and another six. Not only that, but municipalities are taxing or bonding their towns to build improved streets, one city of 20,000 inhabitants contracting to macadamize all their important streets. Individuals are associating together to build sections to lead to these hard roads; thus, as an object-lesson, it is working wonders throughout the whole State. It is probable to-day that a greater number of miles are being constructed in the State outside of than under State and county supervision. Thus the wisdom of this State appropriation is being every day illustrated by steadily transforming a large portion of the roads of our State into a fine condition.

WIDTH OF ROADBEDS.

Although the first cost of a road is practically in direct proportion to its width, the cost of maintenance and repairs is governed largely by the amount of traffic. If the traffic is at all severe, it will be cheaper to maintain a moderately-wide road than a narrow one, on

which, being confined to one track, the traffic will wear more severely than if spread over a wider surface.

The average width macadamized varies as follows: In the United States, 16 feet; in France, between 16 and 22 feet; in Belgium, 8¼ feet, and in Austria, from 14½ to 26¼ feet.

On many of the roads of this State where the traffic is moving mainly in one direction at a time, a macadamized or graveled width of eight feet would be amply sufficient. On roads of more importance, where it is necessary to provide for the frequent passing of vehicles, a stoned width of sixteen feet is necessary. It is probable, however, that a minimum width of ten or twelve feet would be better than eight feet, as the traffic would not be so closely confined to one track and the edges of the roadbed would be less likely to be pushed out. Drivers should be better informed as to the importance of not constantly following one line in using a road and should be instructed to drive over all parts to prevent the formation of ruts, which are great destroyers of roads.

We have settled upon the widths of ten, twelve and fourteen feet as ample for the traffic in the country and sixteen feet in the towns as the limit for State aid. Then, if the municipalities through which they pass, or the citizens thereof, decide that the whole street shall be covered they improve the remainder at their own expense, so the extra paving does not enter into the State's calculation or share of cost.

COST OF ROADS.

The roads now are costing all the way from twenty to seventy cents a square yard. In wet places where telford is necessary the cost reaches seventy-three cents. The cost of the majority of our roads this year in the lower part of the State ranged from fifty to sixty cents a square yard. In the upper part of the State, in Morris and Passaic counties, they are building the bed of stone four and six inches deep; consequently, the expense, where rock is mined along the road, ranges only from twenty to forty-five cents per square yard. The railroads run north and south through the trap ridges, thus the trap can be easily shipped to any portion of the State. The railroads running south cheaply bring the stone to the southern counties at a price almost as low as when transported by rail farther north. The railroads seem to have nearly a uniform price, without regard to dis-

tance, for carrying stone, there not being a difference of more than ten or fifteen cents a ton between long and short hauls, say twenty to seventy miles from the trap ridges. The contract price of our stone roads ranges from three to five thousand dollars per mile. We have built in three sections a continuous gravel road thirty-four miles long, with a branch seven miles long, which cost about $1,400 per mile.

CONTINUOUS AVENUES.

We have adopted a system of continuous avenues, so we have now nearly completed a line which runs all the way from Atlantic City, in the southern portion of the State, to Jersey City, and from Jersey City to the extreme western boundaries of Morris and Passaic counties, while many lateral roads leading to these and to the different county seats and important towns have been improved. In the western section of the State we are building other systems crossing at Trenton which are almost parallel with the first, so that in a few years we shall have several continuous lines north and south through the State. We have started three continuous lines from the city of Trenton, portions of which are already built. The first one leads from the city of Trenton through Pennington, Hopewell, Blawenburg and Belle Mead to Somerville, where it connects with the northern system of roads. Another line, already completed through Princeton to Kingston, is projected from there to Belle Mead, thence to Somerville; also from Kingston by the way of Millstone to New Brunswick. The third line, already built to Edinburgh, is projected by the way of Cranbury, over the Cranbury pike to New Brunswick.

These lines, with laterals, will supply a large area with hard roads, leading from Trenton through good farming districts to the most important cities in the north, central and eastern portions of the State.

From the city of Camden there are seven continuous lines, mostly built, leading southwest, south, southeast, east, north and northeast through highly-cultivated farming districts, to the largest towns lying south and southwest of the city of Trenton. Lines are building and projected in Monmouth county which will in time connect the cities named with the farming districts of Monmouth and with the important towns of the richly-developed Monmouth county seashore.

Several lines are completed, and others nearly so, leading from Paterson and Newark west through Essex, Passaic, Morris and Somerset

counties. In Morris county many lines have been built and are contemplated, leading from Morristown to all portions of the county and connecting with the improved roads of adjacent counties, while nearly all sections of the county are being joined with the important towns located on the Delaware, Lackawanna and Western railroad.

Your Commissioner's desire that continuous lines of improved roadways shall be created throughout the State has been somewhat accentuated by the action of a number of the different Boards of Freeholders. In many counties where numerous roads have been applied for, the Freeholders have accepted all petitions, ordered the survey and specifications of each to be prepared and filed with him, to select those which shall be first built. The power of selection having thus been transferred from the Freeholders to your Commissioner, he has utilized it as nearly as possible in building continuous lines instead of detached sections.

THE LEADING ADVOCATES FOR STONE ROADS.

In the early history of this road improvement in our State, the farmers, except in two counties, were the opponents of the system, fearing it would heavily burden them with taxes; so if it had not been for the wheelmen, the law would probably have failed of enactment. The wheelmen came in force before the Legislature and succeeded in persuading them that it was necessary for the development of the State to enact a State Aid law. The farmers were there in numbers equally strong in opposing it; now, the wheelmen are comparatively quiet, while the farmers are the pleaders and workers, they having filed hundreds of petitions and daily filing more. The reason why our farmers are becoming warm advocates of the law is because they are yearly saving, in the use of the hard roads already built, many thousands of dollars in the wear and tear of the teams and in the cash cost of sending their produce to market, as is illustrated by the following narration of results in carting the products of Gloucester county farms.

THE BENEFIT TO FARMERS.

The question is often asked your Commissioner how the stone roads are of any particular benefit to the farmer, and whether the increased taxation resulting from the building of them does not amount to more than the advantages gained.

This question is more easily answered by citing the practical results in some sections of the State. Gloucester county and the southern part of Camden county are great producers of watermelons, tomatoes, white and sweet potatoes, and many other varieties of fruits and vegetables so largely sold in the city markets.

Before the advent of stone roads, the leading highways not graveled were almost a bed of sand, through which teams struggled with forty to fifty baskets of produce to the Philadelphia market. The roads were so heavy the farmers were largely forced to ship by railroad and by boats passing down the numerous creeks that intersect this portion of the country. The expense on the few baskets they were enabled to carry from the farms to the city was so great they found it much cheaper to send by car or boat.

Now, since the leading roads have been macadamized towards the Gloucester City ferry, there are from 1,600 to 1,900 teams a day passing to and fro on this ferry, where probably from 200 to 400 was the maximum before. These teams now carry from 130 to 175 five-eighths-bushel baskets of vegetables and fruit, while before they only carried from 40 to 50 baskets. They are now carting to market instead of sending by boat, as they mainly formerly did, and returning with 3 and 5-ton loads of manure. Their reason for so doing is that they effect a very large saving. Their experience is that the average basket of fruit or vegetables sent by boat to the Philadelphia markets costs from 6 to 8 cents per basket; the items of expense by boat are 3 cents for freight, 3 cents for atttendant and 1 to 2 cents for carting in city; total, 7 to 8 cents; then if the commission be added, it would average 3 to 4 cents more; total, 11 to 12 cents. By carting an average load of 150 baskets, the farmer saves to the use of his own team about $10 per day; so if he were to cart but 5 days in a week, there would be a saving of $50 per week, less the ferry expenses of 75 cents per day. Another advantage consists in the produce being landed fresh at the commission or consumer's door, thus being in a much better condition for sale than when going through its different stages of handling to and from the boat or cars, and the rough usage of carting to the consignee's door. Then the farmer by marketing his own produce very often saves the commission by being enabled to directly dispose of it to the consumer. The charge for selling is 10 per cent.; on an average load of 150 baskets the commission would be somewhere in the neighborhood of $6. This, added to the $10 saved in transportation, swells the saving to $16 on each load.

This calculation seems large, but if it were one-half realized, it shows how the stone roads benefit the farmers. The result has been, where the early opposition of the farmers of Gloucester county was marked by the sending of numerous persons and petitions to the Legislature, to have the Stone Road law either abrogated or the mandamus or forcing clause stricken out, that applications are being rapidly substituted for the remonstrances, making it impossible, with the limited appropriation, to come anywhere near meeting their petitions.

Another one of the results is that the farmers are rapidly buying larger, heavier wagons with broad tires, and if the present rate of increase keeps on, the capacity of each wagon will be almost equal to that of the small boats formerly used in this carrying trade.

IMPROVED SPECIFICATIONS.

Experience has enabled us to so improve our specifications for stone and gravel road-building that the contractors are enabled to bid a lump sum for their construction, or we can determine beforehand the exact cost of every projected road; so now the actual cost nearly tallies with the estimated expenditure. In the early history of the State Aid improvement there were so many unknown quantities in shouldering, binder and other supplies that the actual cost was often very much more than the estimated one. Our engineers are learning that careful cross-sectioning is absolutely necessary, and by so doing are enabled to get exact quantities. By having prescribed depths for the pavement, the exact amount of stone required is known before commencement. Careful examination of the formations through which the road runs enables determinations of the number of lineal feet of drains required, so that in almost all cases the future cost is calculated beforehand with almost absolute certainty.

The Freeholders are also learning that it is not to the financial interests of the county to change their engineers each time the political complexion of the board changes; they have found they cannot afford to pay by expensive mistakes for the education of an engineer; so they are now mainly employing engineers without regard to their party affiliations, and, in the most of cases, giving them fixed salaries instead of percentages, thus destroying all temptation to increase the cost of the work. The frequent changes of engineers have in the

past lost the counties thousands of dollars, on account of the ignorance of new incumbents of the first principles of road-building. Eight counties have adopted this principle of continuous service, and are receiving benefits through so doing far beyond the amount of the salary of the engineer.

We hope the balance of the counties that are largely entering into the State and county road-construction will adopt the same policy.

TOLL ROADS FOR FREE PUBLIC USE.

The Legislature having passed an "Act to provide for the acquirement of turnpike roads for free public use," petitions were presented to the State Commissioner of Public Roads for the purchase of two turnpikes, namely, the Camden, Ellisburg and Marlton stone road, ten miles long, and the Westfield and Camden turnpike, part stone and part gravel, about eleven miles long.

The Governor having appointed commissioners to estimate the fair and just value of the said two roads, they in due time completed their work, and determined the value of the Camden, Ellisburg and Marlton pike to be $13,043.50, of which Camden county's share would be $37,373.48, and Burlington county's share would be $5,670.02. The State Commissioner has ratified the action of this commission, but the Freeholders of Camden county declined to purchase their portion of this pike; therefore the law has failed in making it a free pike.

The commissioners for the Camden and Westfield road filed their report in our office on May 28th, 1898, they having estimated the value of the road in Camden county at $30,070.16, and the value in Burlington county at $16,451.56; total value, $46,521.72.

Your Commissioner has not ratified their action on account of the want of funds at the time the award was reported to him, the State aid having for the past fiscal year been previously mortgaged for the construction of new roads. The Attorney-General also advised non-ratification of the decision of the commissioners until the State makes another appropriation. These reasons, coupled with the fear that the Chosen Freeholders of Camden county may, as in the Camden and Marlton turnpike, refuse to purchase at the prices named, will cause me to withhold my signature until satisfied that the two boards will ratify the action of the commissioners. If these awards are accepted

by the Freeholders of each county, they will take more than Camden and Burlington counties' share of the State appropriation to pay for one-third of their valuation; consequently, will prevent the building of new roads in these two counties during the year ending October 31st, 1899. The contention of the Camden County Freeholders is that the price named is too high, and if they purchase their share of these two pikes, they will be paying much the largest part of their cost for the accommodation of travel which mostly originates in Burlington county.

The general desire that toll roads in our State shall become things of the past does not as yet seem to materialize, the law failing in its last stages to accomplish the result intended. The Freeholders not deciding to purchase at the prices named by the commissioners, there is no provision in the law requiring purchase. There is no provision for the payment of the expenses and services of the commissioners. These remain unpaid; therefore, in order to make this law effective and more practical, it will have to be amended in several particulars.

TROLLEY LINES.

Trolley lines furnish great accommodations to scattered as well as dense populations. They cheaply distribute settlements over large areas, thus in a manner relieving the congestion of large cities and giving denizens of crowded districts easy opportunities to enjoy rural life. They facilitate intercourse between communities and increase the value of rural lands; therefore, landowners can well afford to give the right of way for their construction. But, like other railroads, they are projected not only for public accommodation but for paying investments. They are great creators of wealth, not only for the builders but the property-holders along their lines. Commercially, this development has already created many millions of wealth, so they can as well afford to purchase the right of way as steam companies are compelled to do, and they should not be permitted to monopolize our public wagonways. The highways were opened for free and unobstructed travel by personal vehicles, and they should be protected from danger from any and all sources. Anything that jeopardizes the safety of those who are compelled to use the public roads defeats, to a large extent, the object for which these highways were built. Where trolleys run they destroy the pleasure of driving,

for those using horses are in constant fear of accident from fright. On many of our highways women and children cannot as a consequence drive with safety. Then, again, the wheels of light vehicles are often strained and those of heavy wagons rapidly destroyed by the grinding of the rims upon the sides of the track and by the frequent turning out required to get out of the way of the rapidly-moving cars, the space each side of the track in many cases not furnishing room enough to travel without using the track; consequently, they almost destroy the purpose for which these thoroughfares were intended. We do not think that residents of rural districts should, with the experience we now have and due consideration of the dangers involved, voluntarily consent to see public wagonways so diverted from their original use. Oil and water will not mix. A trolley car has too much speed for wagons, therefore necessitates a constant turning out to get out of its way. We should not place upon the wagonways any vehicle that cannot turn out to allow the passage of an opposite approaching one, or which will regulate the speed of one moving the same way. We should not place upon our highways any form of vehicle that has special rights over any other, and it is impossible from the speed of the electric car to allow it course over a wagonway without giving it special privileges, which privileges are detrimental to the more slowly moving ones. Therefore, companies intending electric railway construction should never be granted passage over wagon roads when it is possible to obtain a way outside of them. Many promoters of trolley lines acknowledge it is not to their interest to possess such privileges. They have found by having separate roadways they have few obstructions and thus can make, if they need to, a schedule time of thirty or more miles an hour, which would be dangerous to ordinary travel on wagonways. There is a great deal of dissatisfaction expressed where companies have been allowed these privileges. Travelers upon roads in Burlington, Camden and Gloucester counties have often expressed to the writer their regrets that consent had been granted electric companies to pass over their most important highways, where now the residents, instead of having free and unobstructed use of these roads are forced, upon the approach of a car, when driving spirited horses, to hurry to side roads for fear of accident by fright from the closely-passing cars. Land is cheap along our country highways, and many property-holders would be willing to give the land rather than not have trolleys; but even if it has to be

purchased, why should special favors be shown an electric company over steam or any other organization? Then, again, very often the right of way is obtained for the mere purpose of securing franchises upon which to speculate. Operations of this kind are very numerous. The privilege of passing over some of the highways of our State has been bid for and large prices offered, and why the privilege should be freely granted is beyond our understanding.

We hope that our Freeholders, who are the guardians of the different counties, will long hesitate before granting privileges which their constituents, their children and their children's children will have great reason to deplore, on account of the numerous inconveniences, accidents and deaths that will be constantly occurring for generations to come.

Trolleys will soon be carrying freight or produce for farmers to towns and cities, which will be a very desirable result for both consumer and producer; therefore, where possible, these lines should possess their own right-of-way and be entirely independent of the public roads, for all evidence points not only to the attainment of great speed, but to their carrying heavy loads of passengers and freight. Already the Toledo City Council has granted a company the right to run its "rail wagons" on the street car tracks in that city. These wagons are built for the especial convenience of the farmers in the neighborhood surrounding Toledo, and are to be used for bringing the products of the farm to market. The farmers can load these wagons and drive them to the trolley line, where a motor car will pick them up, one after another, and haul them to the city. As this is to be done almost wholly during the night-time, it will interfere little with city traffic.

There is a great future for the trolley, and a large profit in the development of the system; hence long-sighted capitalists are securing franchises in very many directions, and can well afford to buy the land over which they pass, outside of the highways dedicated to public use.

Where trolleys pass in the middle of the road, the macadam should be constructed with two crowns, one on each side of the road, using the track for a drain, for it is impossible to keep a macadam surface in proper shape without a crown where the slope is from the rail to the gutter.

Where possible the rails should be laid on the sides of the road, and

the macadam built in the center with the rails for shoulders, the drainage of the macadam passing on to and over the rails.

James Owen, County Engineer of Essex, says that the interjection of a trolley track in the middle of a macadam road perplexes all who are building roads. The conditions of maintenance of a pavement with a trolley track in it are entirely different from the conditions of the ordinary road on which the travel is uniformly spread over the entire surface. The laying down of a rail, and the laying of a pavement on each side of the rail, cause a distinct and well-defined line of travel on each side of the track. The trouble is that instead of the pavement wearing uniformly over its surface, that *bête noire* of all road engineers—the rut—is started. This question of ruts is one of the most important with which we have to deal. To overcome this difficulty I now make on each side of the track a separate roadway with its own individual crown. Experience shows that the increase of wear and tear and the cost of maintaining a similar area of roadway on each side of a trolley track is about twice what it would be with the ordinary condition of a single macadam or telford road.

Providence, Rhode Island, is honeycombed with trolley tracks, and the same problem of maintenance has arisen; to maintain the road large stones are being used.

The City Engineer of Providence says that the only solution of the trouble is to rip out all the macadam roads and substitute a more substantial pavement, as a macadam could not be maintained in a city alongside of a trolley road.

AUTOMOBILES.

In Paris automobilism may be said to be firmly established, and a great number of private and public vehicles without horses, and of most varied types, crowd the streets of the French capital. The new element has already given a different aspect to the appearance of the public thoroughfares, and the authorities have also begun to give special attention to this new factor of the street traffic. As the first result of official investigation an ordinance has been passed prohibiting the running of automobiles of any type except by licensed engineers or conductors. All horseless vehicles driven by steam-motors must carry an engineer, while electric, benzine or petroleum motors may be managed by a man owning a conductor's license. These engineers and conductors must be thoroughly acquainted with the handling of

The Coming Motor. A Group of Wood's Electric Vehicles. Variety of Design.

Preparing for a run on the boulevards and avenues of Chicago.

The Fischer Equipment Co., of Chicago, manufacture 25 different styles, and are equipped with 2½ and 3½ horsepower motors with capacity to run 25 to 30 miles with one charge. Maximum speed 12 miles per hour. Total weight of cabs 750 to 2,600 lbs. each Hard rubber tires encompass each wheel (Plate by courtesy of The Electric Engineer, New York City.)

their vehicles, and pass an examination before an employe of the city Engineering Bureau, both in managing their carriages and in handling and repairing their machinery. The practical trial takes place over a track half a mile long in the Rue Cardinet, which embraces a steep hill, the steepest in Paris, and all kinds of pavement. To test their ability, dummies of walking persons are placed in the road of the automobiles, and the conductor must prove his alertness and ability by coming down the hill and avoiding any collision with the slat-and-canvas pedestrians. The owners of automobiles wishing to run them personally, in Paris, must also pass their examination or employ a licensed conductor. Thus millionaires are practicing here along with cabbies. In the great Paris Exposition of 1900, motors are to be allowed a very large space; the French Automobile Club proposes to organize an international motor-car congress in connection with the Paris Exposition of 1900.

The Dundee Tramway Company, who, according to good authority, are already employing two or three oil-driven motors, are reported to have placed an order for a motor-car driven by steam.

Germany has just had a motor-car exhibition at Dusseldorf that proved a marked success.

Owing to the bad state of the roads in Russia the idea of holding a great motor-car race from Paris to St. Petersburg has been abandoned, and in its place a race is being organized from Paris to Lisbon.

The business of assembling motor-cars—that is, buying the parts from the different makers and building machines after the manner of the bicycle "assembler"—is reported as the newest phase of motor-car development, proving that there is a good demand for the vehicles. Great Britain is the home of this industry.

The Royal Agricultural Society, which has just held another annual prize contest, has issued the report of the judges, from which it is gleaned that heavy-load motor-wagons worked by steam are "capable of carrying three-ton loads at good speed and very economically on country roads of no specially good surface, and up gradients as steep as 1 in 9."

A motor vehicle worked out on bicycle lines, and capable of seating two persons, weighs but two hundred pounds empty.

It is asserted that the amount of capital invested in the motor-car industry in France is upward of $150,000,000 and 200,000 persons are employed in their construction.

A compressed air-driven motor-gearing, in which the air is compressed continuously "by the ignition of hydro-carbon vapor," is one of the newest forms of motive power applied to motor vehicles.

The English authorities limit the speed of motor-cars to twelve miles an hour. An "Inspector of Motor-car Traffic" has been appointed in Paris, whose duties, among other things, will be to put down furious driving. The Berlin police are also making efforts in the same direction.

The introduction of the motor-car in the army may be the next important development to be looked for. The Austrian military authorities have been experimenting in this direction with the object of using the motor-cars for the transport of cannon and ammunition. In a recent trial an auto-car, laden with a weight of five tons, was driven along mountain roads, and the expert officers in charge assert that the experiment was most successful. The experiments are to be continued by the mountain artillery.

A steam-driven motor-car is to run between Newcastle and Hull, England, the fare being equivalent to one cent per mile.

These facts would seem to indicate that the time is rapidly approaching when they will take the place of the horse and bicycle, all tending to accentuate the necessity of covering the country roads with macadam, which will not be destroyed as with the picking of the horses' feet and the hard tire of the ordinary wagon-wheel, but made smooth with the pressure of the rubber tire that encircles all the wheels of the automobiles.

NECESSITY OF IMPROVED ROADS TO PREVENT CONGESTION OF CITIES AND RETAIN RURAL POPULATION.

We have entered upon the era of gigantic cities. At the present rate of growth in a very few years fully one-half of the population of the United States will reside in cities.

In England, Scotland and Wales three out of four reside in cities. In many European countries the growth of the cities is two to ten times greater than the country. In Massachusetts seventy out of one hundred persons reside in the cities, and this proportion is rapidly increasing. Half the population of New York, six to seven millions, reside in seven cities; three out of four live in some city. Chicago contains about one-third of the population of Illinois. In Indiana

many cities have made great gains, while the country districts lost population. In more than twenty-five thousand townships of our oldest States and Territories more than ten thousand of them lost population. In New York State 69 per cent. of all the townships lost population; in New England, 62 per cent.; in Ohio, 58 per cent.; in Illinois, 54 per cent.; in Indiana, 49 per cent. of all the townships lost population, yet all these States made satisfactory gains in population. This simply means that the cities are absorbing the population of the country districts to a degree unprecedented in the history of the world.

Within the lifetime of one generation the population of the civilized world has doubled, while that of the English-speaking world has quadrupled. The cities will continue to grow—nothing can prevent them; therefore the necessity of improved rural roads to make locomotion easy and country life attractive by facility of intercourse.

The further necessity for these roads is made apparent by the rapid extension of the railways in the United States.

The following quotation will illustrate:

"Railroads have practically annihilated space and brought the prairies of the far West in close competition with the farms of the East.

"Mark its development within forty years, by periods of ten years, as exhibited in the following table showing the comparative mileage:

Year.	Mileage.
1857	24,503
1867	39,250
1877	79,088
1887	149,257
1897	182,776

"The tremendous increase of freight traffic and the substitution of steel for iron rails wrought a revolution in transportation, and proved the two greatest factors in lessening the cost of food. The greater prominence should be given the steel rails, the long life and heavier weight of which permit the use of giant locomotives, freight cars, each a warehouse of no small dimensions, and the making of greater speed. How the reduction in cost worked out is shown by the following record of the comparative freight rate for moving one ton

per mile on the Lake Shore, one of the best-equipped trunk lines of railway in the United States:

Year.	Cents.
1854	3.510
1865	2.903
1870	1.504
1896	.549

"The above shows that the rate in 1896 for carrying one ton per mile was only one-seventh the cost in 1854, but one-fifth that in 1865, and one-third that of 1870. In 1868 the all-rail cost of moving a bushel of wheat from Chicago to New York was 42.6 cents; in 1895, 12.17 cents, a drop in twenty-seven years of nearly 30½ cents, equivalent to a reduction in the cost of a barrel of flour of $1.37. In 1857 it cost 25.29 cents by lake and canal to move one bushel of wheat from Chicago to New York, while in 1895 it cost only 4.11 cents, or but one-sixth the rate thirty-eight years previous. Since 1870 canal rates from Buffalo to New York dropped from 11.2 cents to 3.7 cents per bushel. These figures are indicative of the cheapening of transportation on all articles of food.

"Then, too, the rapid extension of the railway, besides decreasing cost, has made available for cultivation thousands of acres of new land, thus increasing the quantities of all kinds of food suitable for human consumption.

"The refrigerator car, the heater car, the elevator and the cold storage warehouse, and specially-constructed cars for moving fruits, secure the carriage and distribution in perfect condition of any perishable products from any given point of production to any desired market in the United States.

"With all these factors the Eastern farmer must compete; therefore the absolute necessity of lessening the cost of the transportation of his own produce to market through the only instrumentality possible—the improvement of his wagonways.

"One cannot fail to note along our city streets the long list of articles, selling at low prices, which forty years ago were not available except when in season, and rarely then, owing to high cost. Some of these things are carried thousands of miles and are sold at retail at but a fraction of the sum which was paid for transportation alone twenty-five to forty years ago."

VISITS OF THE HIGHWAY COMMISSIONERS OF OTHER STATES.

Since New Jersey has entered upon the mission of redeeming her highways under the stimulus of State Aid appropriations, she has been honored by many visiting delegations from other States, anxious to view the object-lessons she is so rapidly creating. Of the number who have come, New York has sent two delegations from her Legislature, Connecticut, North Carolina and Virginia each one.

During the past year we have had the pleasure of escorting around the State the Highway Commissioners of Massachusetts, Maryland and Rhode Island. We spent portions of several weeks showing them our improved roads. They carried with them their engineers, secretaries and photographers, taking most careful notes and many photographic views along our lines. They expressed themselves well pleased with our construction, and surprised to learn we could build so effectively at so small a cost per mile.

The State of Massachusetts is using $600,000 per year in the improvement of her highways. Their working force consists of 3 commissioners, 1 chief engineer, 2 assistant engineers, 4 division engineers, 5 chiefs of survey parties, 13 transitmen, 20 rodmen, 8 draughtsmen and 140 resident engineers.

Their construction has been more expensive than ours, reaching as high as $25,000 a mile, and seldom less than $6,000 a mile. This is owing somewhat to the rougher topography of the country, necessity of reducing heavy grades, building expensive retaining walls and bridges, and the requirement of their law that there shall be a fair apportionment among the different counties and not more than ten miles constructed in any one county in any one year; therefore there are not, as with us, continuous lines reaching through most of the counties of the State.

In the State of Maryland the appropriation has as yet been small, principally for preliminary work. The Commissioners of Maryland were more interested in our gravel than in stone construction, as their State possesses a large area of territory very similar in its geological formation to the pine or southeastern districts of South Jersey. Over this area heavy beds of gravel have been deposited by natural forces at suitable intervals. Their desire seemed to be to see how we utilized the gravel in the several roads we have constructed and that are now giving such good service in the southern part of the State. We carried them over the State road, from Berlin to Absecon, thirty-four

miles, which, at that time, was and is now in very fine condition, presenting an elegant surface of sufficient wearing qualities for the traffic that passes over it. Their visit also extended over the gravel roads of Asbury Park and Long Branch, and with these they were equally well pleased. The fame of our roads has extended over the Union, as is evidenced by the numerous inquiries from many States as to their continued wearing qualities, utility and popularity, and citizens of other States are frequently expressing their desire for an opportunity to inspect them.

Our roads have become object-lessons for the whole United States, indicating how reformation in the practice of road construction in one locality rapidly spreads until it embraces whole commonwealths.

The Massachusetts Commission was highly pleased with the road stones used in our construction, and kindly agreed to test their wearing capacity by the machine which they have set up and are working in their State Geological Department.

It would be a good investment for our State to make a small appropriation for the same purpose, as the wearing qualities of stone vary so much. Governing bodies should have some absolute and certain test to determine which possess the strongest resistance to wear.

ABRASION TEST OF NEW JERSEY ROAD STONE MADE BY THE MASSACHUSETTS HIGHWAY COMMISSION.

The Massachusetts Highway Commission having kindly consented to test the wearing qualities of some of the varieties of New Jersey traps used by us in road construction, I forwarded to them, from each of the following quarries, fifty-pound boxes containing the average sizes used on our different roads. Upon each box we placed a label showing the locality from which the stone came and by whom sent.

The machine used by them for testing and manner of testing are described further on in a communication from them.

Tue following is the result reported by them:

M. F. Berger's quarry, Byram Station, Hunterdon county, Delaware and Belvidere road, N. J., coefficient of wear, 26.93; Wright & Lindsley stone-crushing works, Great Notch, Essex county, N. J., coefficient of wear, 21.76; Morris County Crushed Stone Co., near Millington, Somerset county, N. J., coefficient of wear, 19.64; Rocky Hill Stone Storage Company, Rocky Hill, Somerset county, N. J., coeffi-

cient of wear, 19.44; Hillpot & Ayres, Bound Brook, Somerset county, N. J., coefficient of wear, 18.61; Francisco Brothers' stone-crushing works, Great Notch, Essex county, N. J., coefficient of wear, 18.59; B. M. & J. F. Shanley, Bergen Hill, Hudson county, N. J., coefficient of wear, 15.03; P. F. McManus, Glen Mills Stone and Quarry Company, Chester county, Pa., coefficient of wear, 14.48.

The following description will be interesting:

Early in the history of the State highway work the Massachusetts Highway Commission recognized the value of having certain tests made on the stones used in the construction of macadam roads, and, with this in view, the Commission secured the services of Mr. L. W. Page, State Geologist, who has also a considerable knowledge of mechanics, to conduct such experiments. The experimental work has been carried on in the Engineering Laboratory of Harvard University, at Cambridge, Mass. The apparatus used has been provided by the university, the only expense to the Commission being for the services of the employes who are engaged in carrying on the tests. The aim of these inquiries has been to determine the nature of the qualities which constitute fitness or unfitness of the different kinds of rocks for use in road-making, the effects of diverse methods of treatment used in the process of construction, and the relative value of the bed-rocks and gravels which are found in the several parts of the State.

The experiments which have proved most useful thus far are the abrasion and the cementation tests. The machines used in conducting these tests were designed by Mr. Page, under the direction of the Commission, the abrasion machine being modeled after the Deval machine, such as is used in similar tests at the National School of Roads and Bridges of France.

The apparatus for making the abrasion tests consists of a cast-iron cylinder 20 c. m. (7.9 inches) in diameter and 34 c. m. (13.5 inches) in depth. At one end is an opening which can be closed with a tightly-fitting iron cover. The cylinder is mounted on an axle at an angle of 30° with the axis of the cylinder, and is supported on an iron frame. At one end of the axle is a pulley-wheel, by which the cylinder is revolved, at the other is an instrument which records its revolutions.

The stones employed for making the abrasion tests with the Deval machine are of such sizes as will pass through a screen with a $2\frac{1}{2}$-

inch mesh and not through a screen with a one-half-inch mesh. In making a test, 5 kilogrammes (11 pounds) of the stone, previously cleansed, are placed in the cylinder; the air-tight cover is then screwed on, and the cylinder rotated at the rate of 2,000 revolutions per hour. A revolution counter attached to the shaft is frequently consulted, and permits the control of the regularity of the machine. The rotation of the cylinder throws the fragments of stone from one end of the cylinder to the other twice in each revolution, and causes them to grind against one another and against the walls of the cylinder. At the end of five hours, or 10,000 revolutions, the machine is stopped, the cylinder opened and the contents emptied into a basin. The cylinder and the cover are carefully washed, and the water used is poured into a basin. Each stone is then washed and brushed under the water, and is thus cleansed from the adhering dust, which remains in the water as a sediment. After it is dry, the detritus is emptied into an automatic sieve which separates that below .16 c. m. (1-16 of an inch) from that above. The per cent. of the .16 c. m. dust may be taken as a coefficient of wear, or the coefficient adopted by the French School of Roads and Bridges may be adopted by the formula,

$$\text{Coefficient of wear} = 20 \times \frac{20}{w} = \frac{400}{w}$$

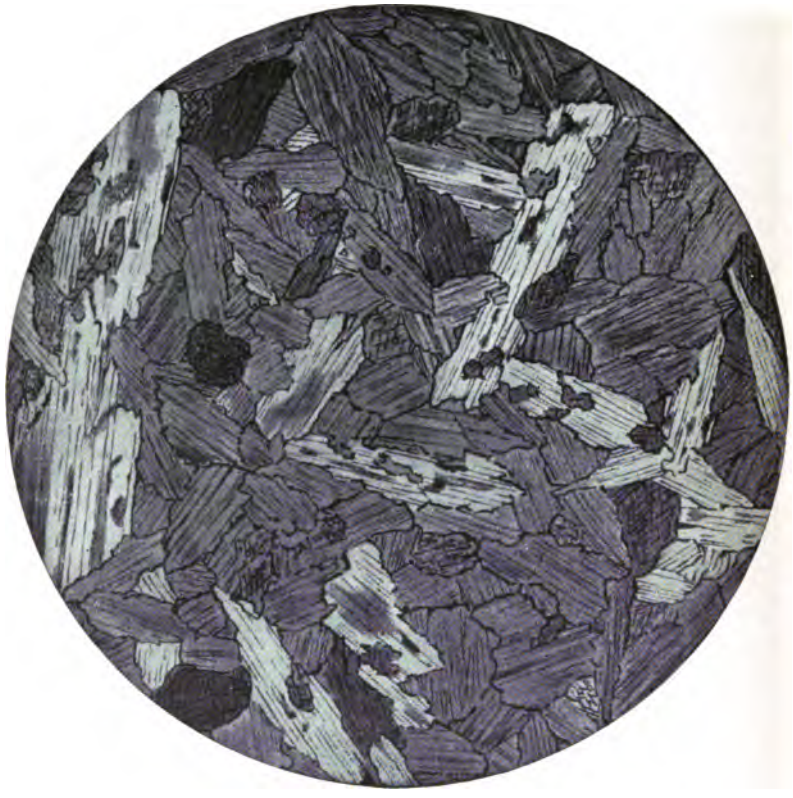
where "w" is the weight in grammes of the detritus less than .16 c. m. (1-16 of an inch) in diameter obtained per kilogramme of stone.

Great care is taken to make the tests of all specimens under precisely similar conditions, so that all results are comparable. The results of about 170 tests with the Deval machine can be seen in the 1898 Report of the Massachusetts Highway Commission, pages 63 to 68.

The results of some of the tests on the more common rocks are given below:

	Highest Result.		Lowest Result.	
Kind of Stone.	*Coeff. of wear.	Per cent. of wear.	Coeff. of wear.	Per cent. of wear.
Diabase (Trap)	30.40	1.31	9.28	4.31
Granite	21.16	1.90	8.41	4.76
Felsite	19.91	2.01	12.30	3.25
Gneiss	23.02	1 73	5.01	7.98
Limestone	17.20	2.33	6.31	6.34
Schist	12.52	3.19	4 87	8.20
Quartz	20.34	1.97	9 07	4.41
Field stone (erratics)	19.19	2.08	5.43	7.30

*On the French system



Trap-Rock, Showing Interlocked Structure.

The Commission has also in view the study of the cementing properties of the various kinds of gravel found in the State. It is hoped that an effective size of gravel may be established, and the best method of holding the gravel in place on the roads by some binding material which will not only stand the wear of traffic, but which will also resist the action of the elements and not rut when the frost comes out of the ground in the spring.

The Commission is also conducting experiments to determine the cementing value of stones with machines especially designed for the purpose.

It would be a wise expenditure for the State of New Jersey to make a small appropriation to enable the Geological Survey to make the abrasion and cementing tests similar to those made by the Massachusetts Commission.

TRAP-ROCKS.

Trap-rocks, where obtainable, should always be used in road construction, they being harder and tougher than the best of other rocks. In practice, the qualities which are commonly regarded as essential in the road stone are resistance to crushing and abrasion, cementing and recementing value, and freedom from attack of organic or inorganic acids. Traps have a crushing strength of 29,000 pounds to the square inch, and a coefficient of wear ranging from 14 to 30. Then the uniform hardness and toughness of pyroxene, hornblende and feldspar, which form so large a part of their composition, gives them a dominant position in the ranks of road stone.

Quartz, the hardest of our common minerals, is very brittle, and when used alone is undesirable, as its dust lacks in cementing power. Rocks as soft as limestones, shales and slates quickly grind to powder, and are rapidly carried away by wind and water. Dust, resulting from abrasion, should be free from mica, and possess a high specific gravity in order that water and wind action may be reduced to a minimum. Trap-rock possesses nearly all of these qualities. The minerals composing traps are interlocked with each other in such a perfect manner as to make their toughness and crushing strength very great.

In granites the structure is granular, with little tendency toward interlocking, and with more or less of mica and quartz in their composition, taking the place of hornblende and pyroxene in trap; hence their comparative inability to withstand wear. Traps in decomposing yield, among other substances, a certain amount of lime, clay, quartz

and iron oxide; the dust resulting possesses great capillary attraction, consequently great binding power. The lime derived from the alteration of the feldspar of the traps acts, to a limited extent, as a binding material, tending to strengthen the rock-dust, and increases its attachment to the broken stone.

In construction of roads, water acts as a lubricant, allowing the stones to slip by one another with great freedom; also holds the powdered rock between the fragments. The presence of the powder, through capillarity, takes up and retains great quantities of water until the spaces between the pieces of broken stone become completely filled with powdered rock. Much of the cementing and binding of a road during rolling is the effect of capillarity existing between grains of powdered rock and the adjoining walls. When a macadam road is thoroughly compacted, the spaces between are filled with fine powdered rock. By the gradual wearing of the feldspar, the clay it contains is gradually liberated, and this, in combination with any clayey material that may have been added to the road, serves to furnish the necessary quantity of cement to knit the broken stone firmly together. Nothing is more undesirable than the clay element in highway construction, yet a little mixed with limestones serves to increase their cementing and enduring qualities. Upon drying, the powdered rock sets much after the manner of a sandy clay, and serves to bind and to retard the wear due to any differential motion of the fragments over one another while the load is passing along the road.

A wetting of the superficial portion of a roadway during rains tends, by the expansion of the cement, to knit the surface together and make it impermeable to the passage of water.

COMPOSITION OF TRAP-ROCK.

The following is a list of the most important substances that enter into the composition of a good trap-rock:

Silica (Silicon dioxide, $Si\ O_2$).
Iron (Ferric oxide, $Fe_2\ O_3$).
Alumina (Aluminum oxide, $Al_2\ O_3$).
Magnesia (Magnesium oxide, $Mg\ O$).
Lime (Calcium oxide, $Ca\ O$).
Soda (Sodium oxide, $Na_2\ O$).
Potash (Potassium oxide, $K_2\ O$).
Phosphoric acid ($P_2\ O_5$).
Carbonic acid (Carbon dioxide, $C\ O_2$).
Water.

CHEMICAL ANALYSES OF TRAP-ROCKS FROM DIFFERENT QUARRIES IN THE STATE.

Freeman & McCullum Trap-Rock.

Quarry at Mine Brook, N. J.

Silica	50.61 per cent.
Iron Oxide (Fo)	13.91 "
Alumina	18.34 "
Lime (cal)	7.01 "
Magnesia (mgo)	6.73 "
Potash (K O)	0.08 "
Soda	1.60 "
Water	1.72 "
	100.00

This trap-rock is extremely hard and tough.

Stevens Institute of Technology, Department of Analytical Chemistry, Thos. B. Stillman, M.Sc., Ph.D.

The Somerset Stone Crushing Company.

Quarries at Bernardsville, N. J.

Name, trap or doleryte. Color, dark greyish blue, crypte. Structure, finely crystalline, with prominent crystals of magnetite. Resistance to fracture under impact, very tough. Resistance to crushing, very strong. Hardness, very hard. Component parts, calcium carbonate, 11 per cent.; magnetite, 12.8 per cent.; pyroxene, bi-silicate of magnesia, and habardite, un-silicate of alumina, magnetic oxide of iron, calcite.

Extract from report of Professor Charles McMillan, C.E., of Princeton University: "Your stone is undoubtedly a tough and rather fine-grained trap-rock."

Rocky Hill Stone Storage Company.

Quarries at Rocky Hill, N. J.

Silica	52.29
Iron $Fe_2 O_3$	14.30
Alumina	16.68
Lime	9.35
Magnesia	4.58
$Na_2 O$	2.80
$K_2 O$	0.48

Morris County Crushed Stone Company.

Quarries at Millington, N. J.—Two samples.

	No. 1.	No. 2.
Silica	50.03	51.20
Aluminum	18.20	20.88
Ferros oxide	16.81	11.12
Lime	11.10	12.50
Magnesia	1.02	2.17
Alkalies	1.03	1.03
Water	1.81	1.10
	100.00	100.00

STEEL RAILS FOR COUNTRY ROADS.

Secretary Wilson, of the Agricultural Department at Washington, has a plan which, if successful, is designed to give the farmers of the country smooth and hard roads at all seasons of the year and at a cost not much greater than that required in building ordinary country roads. The plan, as outlined by Secretary Wilson, is to make them of steel, which at the present cost, offers the best and cheapest material. The proposition is to have sample steel roads built at several points in different parts of the country to show the public what can be done. The rails are to be flat, and the obstacle of original expense, he believes, is to be overcome by the reduced price of material, and the anticipated high cost of maintenance is to be avoided by doing away entirely with wood in the construction. The danger of horses slipping on the rails in going up or down hill is met by indenting the rails used on grades sufficiently to catch the calks of the shoes without roughing the tread for the wheels. The difficulty of "low joints" is met by making the joint stronger than any other part of the track, and the danger of forming a rut alongside of the rail is overcome by making every rail joint serve as a "remount" for wheels. The form of rail proposed is an inverted trough with a slightly-raised bead on the inside. The rail is to be bedded in gravel laid in a well-drained trench. A little gravel is to be spread between the rails for the horse path. The rails are to be tied together at the ends and in the middle. The advantage claimed for the steel road is in the reduction of the pull required to move a load from an average of forty pounds per ton on macadam road to eight pounds on the steel track.

Other experiments in road-making are also to be made under the direction of the department. In sections where stone is scarce, experiments are already being made for the construction of roads of a single course of vitrified bricks set on edge, laid on sand, and between curbs of oak plank. A suggestion has also been made for an experiment with brick tramways for wheels and gravel between for the tread of horses. A thorough test of brick roads, it is stated, has been made in a county in Ohio, where they have proven so satisfactory that they are being extended in several directions. The plans for their extension call for a stone curbing on both sides of an eight-foot track of brick, the remainder of the road, twenty feet wide, to be graded but not paved. The cost of these roads is much higher than that of a steel trackway at the present price of that material.

Material for steel roads of the heaviest class of the present design costs in small quantities about $3,500 per mile. It requires less than one hundred tons per mile, and if present prices of steel should be maintained, material for long lines of road can be furnished for about $2,000 per mile. The lighter class of steel rails for ordinary country roads, it is said, need not exceed fifty tons per mile and need not cost much over $1,000 a mile, the cost of grading and laying to be added.

A very large amount of money is expended every year in keeping our roads in repair, and in experiments upon better methods of road-building, and still there are seasons of the year when the roads generally are unfit for carting ordinarily heavily-loaded wagons. Any cheap method of obviating this difficulty without materially increasing the cost of repairs, will be a great relief to the farmers. It would seem that the steel rail comes very nearly meeting this requirement. It seems to be a practicable method, but experiment alone can solve the problem. If the scheme should prove a practicable one, much of the money now annually expended for the purpose of keeping our roads in passable condition will be saved, besides affording a road which can be used for the transportation of the heaviest loads at all seasons of the year.

The public will await the result of the experiments now in progress with much interest.

Hon. E. G. Harrison, United States Special Agent and Expert, is carrying out Secretary Wilson's idea by building specimen steel tracks in different parts of the country.

The following is his description of his experiment at the Omaha Exposition:

"Our steel track is a great success and seems to please everyone. We made a test by putting nine tons on three wagons and drawing them with one small pony weighing about one thousand pounds. The wagons weighed two tons, making eleven tons in all. The horse not only moved the load easily but walked along with it without much effort. We made the same trial at the Experiment Station at Ames, Iowa, and met with the same results.

"Why cannot New Jersey arrange to have a sample put down somewhere? You were the first one I ever heard suggest steel track, in 1892. One hundred and fifty feet will cost $150 at present prices, only getting small samples. This includes steel ties every seven feet. It costs but little to put it down in a gravel road or on a macadam bed. I think some county could afford to make an appropriation of, say, $250 or $300. Why not Burlington and Mercer counties at Mount Holly and Trenton?

"The cost will soon be down to $1,500 per mile for the steel material for the track. The ex-Mayor of Burlington, Vermont, has ordered two thousand feet on his own account for a road from his factory to a macadam road."

THICKNESS OF ROADS.

Mr. Lewis, C.E., says: "Why make a macadam more than six or eight inches in depth? A road of this thickness made with two courses of broken stone will certainly sustain any load which it can be called upon to carry. The real value of a road per mile increases with its length, not with its depth, and the public money can best be expended by increasing its length. Macadam roads six and eight inches thick and twelve feet wide are sufficient for country districts." Calvin Tomkins, M. Am. Soc. C. E., says that on the subject of thick and thin roads, as far as his experience goes, the heart of road-building consists in making a thin road go just as far as possible. It is not necessary to build even eight-inch roads in country districts. Generally, where there is a sandy bottom and a drainage easily taken care of, if a little more is spent for drainage where the bottoms are not so good, a thin road can be made to do as well as a thick one, and money will be saved. As Mr. Lewis truly says, a road is valuable to the people who use it, not according to its thickness, but according to its length and width. If the base is kept dry by protecting it on the sides with ditches and drains and by constituting the road-

bed's surface virtually a roof to shed the rain, the road is just as effective from the engineer's point of view as a sound tooth—it simply consists of a hard surface upon a soft base. In order to accomplish this it is desirable to consider first the question of filling and thoroughly rolling the roadbed, and, consequently, of cementing the pieces of stone together and keeping them in that solidly-set condition regardless of wet, dry or windy weather. Thin roads subjected to light travel can be built more cheaply and maintained more effectively when constructed of other material than trap-rock or granite, since it is possible to cement such roads together when it is not possible to do this with the harder stone by itself.

C. A. Roullier, M. Am. Soc. C. E., says that the expansion of good roadwork throughout the country depends very much upon the question, how thin can roads be safely built? A roadbed having been constructed strong enough to safely carry the traffic that it is intended for, the condition of the surface becomes absolutely independent of the thickness. The condition of the surface will be dependent on suitable design and proportion, good workmanship and intelligent maintenance. By this is meant that if the thickness of the roadbed has been so proportioned that it will carry the traffic without being cut through and a certain factor of safety added to that thickness, further increase will certainly not insure a better surface; hence, why should a certain limit of thickness be exceeded, providing that limit can be determined?

I have found that in building thin roads it is almost impossible to get successful work with a soft binding material. It is absolutely necessary to use a binding material that is hard and coarse, so as to prevent any possible motion in the mass. If motion occurs in a thin roadbed, failure is bound to follow. Sand and coarse screenings, as a rule, give the best result. Failures in thin roads, then, come through the use of a soft filler. In filling these roads I had considerable success by adding to the filling of sand trap-rock screenings and a slight amount of clay in some cases; in others, limestone dust, about 30 per cent. in each instance. The raveling in those cases was materially reduced, and the roadbeds could be left exposed to the weather without detrimental effect.

J. J. McLaughlin, M. Am. Soc. C. E., says that as far as the sustaining power of a thin road is concerned, he would like to corroborate Mr. Roullier. As a good example of the application of his

theory, he says in the village of Jamaica, in 1897, there was a stretch of street about three-fourths of a mile long, parallel to two roads then being improved. The work was done in the spring of 1897, after a a sewer had been laid in the same street. It was built of four-inch stone spread loosely and then rolled. From actual count, there were from eighty to one hundred heavy loads per day, carrying ten thousand and eleven thousand pounds each, for over three months, running over this piece of road, and only in one case where there was some careless work over a sewer trench, was there any material sign of wear, and in no place a break. There was not a square yard of the street broken that had carried these wagons. A road may be built poorly, but if there is an adequate system of maintenance put behind the construction, the road can be saved and made very good. Queen's county has the best system of maintenance. After a road is well constructed, it is immediately passed into the hands of the parties who maintain it. The roads are divided into twelve-mile sections, and each section is in charge of a foreman, who employs a small gang of men. These men keep the stonework slightly covered with a mixture of gravel and loam, mend slight depressions, keep the gutters cleared out and the wings or earth shoulders free from grass and weeds. These earth wings are plowed and re-formed when necessary, in order to provide earth roads with good drainage.

Warren B. Travell, Jr., M. Am. Soc. C. E., has built six sections of roads in the upper part of New York City of different kinds of material, one-half, three-quarters and two inches in depth. These roads were fifteen feet wide and cost from eighteen to twenty-four cents per running foot. More than a year has passed since this work was completed, no new material having been added in the meantime except a few loads of gravel screenings, and the surface, except in two instances, has been well maintained.

MATERIALS FOR BINDER.

Mr. Lewis, C.E., says that limestone screenings as a filler with trap-rock give excellent results. So also does Roa Hook gravel from the Hudson river, near Peekskill. It has given admirable results in binding roads and in patching up the surface. His specifications provide for the binding material for trap-rock roads, 60 per cent. of which shall consist of trap-rock screenings and flour, and

40 per cent. of selected coarse sand or fine gravel, preferably mixed with a little clay or hardpan or limestone screenings.

Mr. Roullier thinks sand and coarse screenings give the best results with trap-rock, a slight amount of clay or about 30 per cent. of either clay or limestone dust added.

MARCELLUS SHALE AS A ROAD BUILDING MATERIAL.

As some engineers have asserted that some kinds of shale make an excellent material for roads, there has been some movement made towards calling the attention of those interested in road-building to the different kinds of shale existing within and on the borders of our State. My attention has been particularly called to a nearly continuous ridge six miles long of Marcellus shale—quartzose sandstone. This formation extends from Port Jervis south along the Delaware river. A company to mine and distribute this material is building a road from Port Jervis down. The road running along the foot of this ridge from Port Jervis down is one of the best natural roads that it has been my lot to travel over. The shale, when thrown on the surface of the roadway, seems to form a firm, compact bed, resisting wear almost like trap, forming as compact a body as the best of gravel, and has every indication of making an excellent binder for trap-rock, making a finer surface for the harder rocks. Quite a large quantity of it has been spread upon a driveway in Central Park, and, from present appearances, it makes a road very much resembling an asphalt pavement. The limited area over which it has been used does not give us sufficient data to indicate whether it will stand up under all the changes of weather, but the fine roadway which it makes in Pike county, Pa., and the splendid showing it makes in Central Park would seem to indicate that it possesses sufficient merits to attract attention of road-builders, and no doubt the energy of the company which has it in charge will give it a wonderful impetus throughout the different portions of the State by offering to road-builders a limited amount of it to experiment with on their roads. We have no interest in this material, but believe that it would be to the interest of road-builders to experiment with different materials to see which are the most economical and efficacious to accomplish the end of permanently improving our public roads.

For the benefit of those who may have a desire to experiment with the material, we will give the address of the company working it, the same being No. 41 Pine street, New York City.

GRAVEL SURFACE ON STONE FOUNDATION.

In some portions of the country very cheap and substantial roads have been made in the following manner:

Instead of making the separate layers entirely of gravel, a foundation course of earth rubble is placed, somewhat after the manner of telford foundation. Upon the rough rubble bottom is spread a layer of broken stone one and a half inches in diameter. After this layer is properly spread, shaped and rolled, the gravel top is put on, moistened and rolled, the gravel being mixed with the binding material or not, as its nature requires.

This plan is recommended where the traffic is not too heavy, and for country roads where materials are conveniently at hand. It makes a most excellent form of gravel road—smooth, durable and easily maintained.

The following is a copy of the specifications for its construction:

The streets shall be excavated or filled to the grade given by the engineer, and the surface prepared for receiving the rubble.

On the surface so prepared a layer of large-size rubble shall be thrown. This course shall be arranged in a close, compact form, and the interstices of the large stones shall be filled in with sound stone chippings. The stones for the foundation course shall be generally not less than five inches in any dimension.

Over the foundation course a layer of rubble, broken as nearly as possible to a cubical form, not less than one inch and not more than two and one-half inches in any dimension, shall be placed, and the rubble shall be well compacted and rolled.

Over the rubble a layer of screen gravel, mixed with clay, shall be placed, and the layer shall be, when finished, at least two inches in thickness at the center and one inch at the side. The layer shall be well rolled and compacted with the roller.

Both before and while rolling the rubble, the gravel layers shall be flooded or sprinkled. The work of compacting the gravel should proceed from each side towards the center, so as to counteract the tendency of the gravel to work out from the center towards the sides.

COMPARATIVE UTILITY OF STEAM AND HORSE-ROLLERS.

There is much dispute over comparative value of steam and horse-rollers. No single item of investment in the whole category of road-making machinery will pay a more substantial and more certain return to its owner than a good roller, and this is likely to be true whether the roller is operated by steam-power or by horse. But when the purchase of a roller is a question which presents itself to the authorities of a town there are generally several points to be considered before a decision can be wisely arrived at. It is not always wise to scrutinize too closely the figure which represents the first cost of the machine, for, while a horse-roller may within a reasonable time perform the task in view, if extended work is not contemplated, it is generally regarded as inferior to the steam-roller in the quality of the work it performs and considerably more expensive to operate in accomplishing the same results.

BINDING MATERIAL.

Clay, sand, gravel, stone screenings and slag are used for binding broken stone. Slag is obtainable only in certain localities. Clay will give a quick result without much rolling, but roads made with clay binder are apt to be very dusty in dry weather and sticky, muddy and rutty in wet weather, as the clay comes to the surface under the pressure and vibration of the traffic. The use of clay in thin road-beds, without artificial foundations, will give very poor results. For this particular class of work a hard binding material is essential; screenings and sand or fine gravel will give the best results if properly treated.

ROLLING.

In using hard binding material a steam-roller is essential for speedy results; on a clay-bound road a lighter roller will answer. For general purposes rollers weighing ten or twelve tons are the most advisable. Rollers weighing more than twelve tons are difficult to handle when taken off hard roads, as is likely to occur in any districts where roads are in construction.

Theoretically the twenty-ton roller is all right; practically, it is not.

WIDTH OF TIRE ON DRAFT OF WAGONS.

The macadam roads of New Jersey are becoming so numerous, presenting such a vast area of surface for maintenance, it behooves us to educate ourselves against all destructive agencies. Narrow tires being one of our worst enemies, we believe the careful pondering of the following article will result in persuading many to reform their tires, thus producing a double benefit: First, saving the roads from rutting; second, saving a large percentage of the wear and tear of their draft teams.

"Tests of the draft of wide and narrow-tired wagons have been made at this station during the past two years on macadam, gravel and dirt roads in all conditions, and on meadows, pastures and plowed fields, both wet and dry. The draft has been determined by means of a self-recording dynamometer. The net load was in every trial the same, namely, 2,000 pounds. Contrary to public expectation, in a large majority of cases the draft was materially less when tires six inches in width were used than when the tests were made with tires of standard width—one and one-half inches.

"The following is a summary of the results:

"1. On macadam street, as an average of the two trials made, a load of 2,518 pounds could have been hauled on the broad tires with the same draft that a load of 2,000 pounds required on the narrow tires.

"2. *Gravel Road.* In all conditions of the gravel road, except wet and sloppy on top, the draft of the broad-tired wagon was very much less than that of the narrow-tired wagon. Averaging the six trials, a load of 2,482 pounds could be hauled on the broad tires with the same draft required for a load of 2,000 pounds on the narrow tires.

"3. *Dirt Road.* (*a*) When dry, hard, and free from ruts and dust, 2,530 pounds could have been hauled on the broad tires with the same draft required for 2,000 pounds on the narrow tires. (*b*) When the surface was covered with two or three inches of very dry, loose dust, the results were unfavorable to the broad tire. The dust on the road in each of these trials was unusually deep. (*c*) On clay road, muddy and sticky on the surface and firm underneath, the results were uniformly unfavorable to the broad tires. (*d*) On clay road, with mud deep, and drying on top, or dry on top and spongy underneath, a large number of tests showed uniformly favorable

to the broad tire. The difference amounted to from 52 to 61 per cent., or about 3,200 pounds could have been hauled on the broad tires with the same draft required to draw 2,000 pounds on the narrow tires. In this condition of road the broad tires show to their greatest advantage. As the road dries and becomes firmer, the difference between the draft of the broad and narrow tires gradually diminishes until it reaches about 25 to 30 per cent. on dry, level, smooth dirt, gravel or macadam road, in favor of the broad tire. On the other hand, as the mud becomes softer and deeper the difference between the draft of the two types of wagons rapidly diminishes, until the condition is reached when the mud adheres to both sets of wheels; here the advantage of the broad tires ceases entirely, and the narrow tires pull materially lighter. (*e*) Clay road, surface dry, with deep ruts cut by the narrow tires in the ordinary use of the road. In every trial the first run of the broad tire over the narrow-tire ruts has shown a materially-increased draft when compared with that of the narrow tire run in its own rut. The second run of the broad tires in the same track, where the rut is not deep, completely eliminated this disadvantage, and showed a lighter draft for the broad tire than the narrow tire showed in the first run. Where the ruts were eight inches deep, with rigid walls, three runs of the broad tire in its own track over the ruts were required to eliminate the disadvantage. Three runs of the broad tire over this track have in all cases been sufficient, however, to so improve the road surface that both the broad and narrow-tired wagons passed over this road with less draft than the narrow tires did in the original ruts. In addition to the saving of draft, the road was made very much more comfortable and pleasant for the users of light vehicles and pleasure carriages by the few runs of the six-inch tire. Summing up all the tests on dirt roads, it appears that there are but three conditions on which the broad tires draw heavier than the narrow tires, namely, (1) when the road is sloppy, muddy or sticky on the surface and firm or hard underneath; (2) when the surface is covered with a very deep, loose dust, and hard underneath; (3) when the mud is very deep and so sticky that it adheres to the wheels on both kinds of wagons. It appears that the dust must be extraordinarily deep to show a higher draft for the broad than for the narrow tires. The three conditions just named, therefore, are somewhat unusual and of comparatively short duration. Through a majority of days

in the year, and at times when the dirt roads are most used, and when their use is most imperative, the broad-tired wagons pull materially lighter than the narrow-tired wagons.

"4. A large number of tests on meadows, pastures, stubble-land, corn ground, and plowed ground in every condition, from dry, hard and firm to very wet and soft, show, without a single exception, a large difference in draft in favor of the broad tires. This difference ranged from seventeen to one hundred and twenty per cent.

"5. It appears that six inches is the best width of tire for a combination farm and road wagon, and that both axles should be the same length, so that the front and hind wheels will run in the same track."

[By H. J. Waters, Director of Missouri Experiment Station.]

GOOD ROADS—THOSE OF DIRT ARE THE MOST EXPENSIVE.

Professor J. A. Holmes, of North Carolina, has written a letter on good roads, in which he says:

"Dirt roads are the most expensive roads that can be used.

"Macadam roads, properly constructed, are the most satisfactory and the cheapest roads yet discovered.

"Trained labor and competent engineering supervision are as important in building public roads as they are in the building of railroads, or any other special business.

"Convicts make cheap and satisfactory road-builders, and every short-term convict in North Carolina ought to be at work on the public roads of the State.

"Hills and mud-holes, both of which are avoidable, are the two most expensive features about the dirt roads.

"All road work should be done with a view to its permanency. A poorly-built macadam road is largely a waste of time and money.

"Good roads are expensive, but in the long run they are far cheaper than bad roads.

"The bad roads in North Carolina to-day cost her people in labor and money but little less than $10,000,000 a year, and yet over two-thirds of the counties in the State will refuse to levy a small pittance of a tax for good roads which would help throw off this terrible burden.

"This enormous bad-road tax is to-day the biggest factor in the industrial depression from which our people are suffering. It is as real a tax as any man ever paid. It is the largest tax we pay."

STONE COMPARED WITH GRAVEL.

One universal reason given for not building stone roads is that they are an expensive luxury. While this may be true in some cases, yet in most cases it is far from true. The difficulty comes from the fact that most of our road-builders fail to look beyond the present year, and simply make a comparison of cost without regard to the length of time the road will be used without extensive repairs. If a road costs fifteen cents a square yard to build of gravel, clay, or other cheap material, and will last five years, we must figure the cost for a term of twenty-five years as seventy-five cents, or three cents per square yard annually. If the same road can be built of broken stone for, say, sixty cents a square yard, and will stand twenty-five years without repairs, the annual cost becomes two and one-quarter cents per square yard. A comparison extending over a second term of twenty-five years will show a still greater saving, as the cost of the poorer material would continue on in the same manner, while the cost of repairing the macadam would probably not exceed twenty-five cents a square yard, to make it last through the second term. While these figures may not be absolutely correct, yet they do apply to hundreds of roads. When it is considered that the work-producing power of a horse is increased from 20 to 40 per cent. by the use of the macadam road, it will readily be seen that it is bad economy to build a cheap road.

N. P. Lewis, M. Am. Soc. C. E., says that the idea that hard, smooth roads are a luxury beyond reach in the rural districts is gradually giving place to the conviction that all roads can as well be good as bad, and that the money used in maintaining them is profitably expended. Many efforts have been made to express in dollars and cents the cost of bad roads, and the figures deduced have been astounding. In Virginia, for instance, which it must be admitted is not famous for good roads, it is stated that the interest on depreciation of land, the additional cost and time lost in hauling, and the annual depreciation of vehicles, horses and mules amount to $1,275,000, which is nearly $2,500,000 more than the total tax collected in the State. The

Secretary of the National Congress has estimated that the needless cost of moving farm products in the United States—that is, the cost beyond what it should be—is $600,000,000 a year.

Prof. Latta, of Purdue University, basing his estimates on the conditions in Indiana, concludes that the difference between good and bad roads is 78 cents per acre of farm land, or $500,000,000 for the entire United States. The fact that poor roads are the source of great expense, has been so well demonstrated that great enthusiasm for the subject has developed, and is fast breaking down indifference and prejudice and resulting in the permanent betterment of the roads.

SUCCESSFUL FARMING DEPENDS UPON GOOD ROADS.

Successful farming depends more upon good roads than is generally supposed. The balance between the cost of production and the market values of his farm products is the margin of profit to the farmer. To increase this profit, then, it is necessary either to lower the cost of production or raise the market value. It does not lie in the power of the farmer to raise the market value; he must, therefore, depend upon the decreased cost of production for his increased profits. In this lies the farmer's success or failure.

To illustrate more fully this cost of poor roads to the farmer we will suppose that he is in possession of a farm of 120 acres, located at least three miles from the market. On a good road he can draw four loads of one ton and a half each, or six tons to market daily. On the average poor road he can draw but two loads and only a little more than half the weight for each load, or only two tons per day. It would then require three teams and three men to do the same amount of hauling on the poor road that one man and one team could do on the good road. A farmer should ship from a farm of 120 acres, under a good state of cultivation, at least 150 tons annually. To haul this produce from the farm to market on a good road would require, at six tons a day, twenty-five days. Allowing $3 a day for the team and man, the cost of this transportation would be $75. Upon an average poor road it would take seventy-five days for one team and a man to haul this produce, which, at $3 a day, would amount to $225. It would, then, cost $150 more to carry the annual products of this farm over a poor road than over a good road. Here is where the money goes. The good road, therefore, saves the farmer just that

In wet and wintry weather, when most needed for country carting.

The cost of shipping a bushel of grain to-day from Chicago to New York is one-fifth of what it was at the close of the war, and the cost of shipping it from New York to Liverpool is only four cents where it used to be ten and one-half cents; but the cost, in time and effort, of man and beast, in hauling wheat from the farm to the railway can only be reduced by macadamizing such roads as are pictured above.

amount which would pay the interest on an indebtedness of over three thousand dollars ($3,000) at 5 per cent., or, in other words, it would add $3,000 to the value of his farm. Poor roads, then, are instrumental in decreasing the farmer's profits. This amount is an actual loss, which should be guarded against, and which can be prevented by a proper consideration of the needs of the highways.

Not only do poor roads decrease the profits of the farmer, but they also reduce the value of the farm. All values are determined by the amount of profit. On 'Change there are no ideal values. The first question always asked is, what rate of interest will the investment pay? If the value of the stock of a certain railroad is fixed at a certain amount and its net earnings only pay 3 per cent. interest on this estimate, its actual value decreases to fifty cents on a dollar. So a farm may be estimated as worth $10,000, but if it only produces enough to pay 3 per cent. on this value, its actual value instantly drops to $5,000. We will suppose, then, that poor roads have increased the cost of transportation of the products of the farm to the market, thereby lessening the amount of profit, as the amount of profit is thus lessened in the same proportion as the value of the farm is decreased.

BURDENS OF QUICKLY IMPROVING TOWNSHIP ROADS BY BORROWING.

The average rural township now pays a yearly road tax of from ten to fifteen cents per acre of its area. One of six miles square, or 23,000 acres, at twelve cents per acre, pays $2,760. Such a township would possibly require fifty miles of road, costing $200,000. Three per cent. on one-fourth of that sum would amount to $1,500 per annum. This would leave, out of the present tax, $1,260 for repairs of roads, and that amount, $25 per mile, if well expended, would be quite sufficient to keep the new roads in good repair.

It is stated by Mr. A. J. Cassatt, who is excellent authority, since he brings business method and a keen insight into the hazy field of country road work, that the cost of maintaining a good macadam road under the wear of rural traffic, is not over $10 per mile yearly.

Under this arrangement the township need not increase its present road taxes at all, and the burdens would soon be removed by the increase in taxable values.

HOW TO FINANCE FOR BUILDING HARD ROADS.

Colonel Pope's plan for building good roads without taxing the savings and the earned incomes of the merchant and farmer.

Let each State establish a graduated succession tax on legacies and inheritances. Such a tax might be arranged as follows: On all estates valued at $10,000 up to $1,000,000, 1 per cent.; on estates over $1,000,000 and up to $5,000,000, 1 per cent. on the first $1,000,000, 2 per cent. on the remainder; on estates of over $5,000,000 up to $10,000,000, 1 per cent. on the first $1,000,000, 2 per cent. on over that sum up to $5,000,000, and 3 per cent. on $5,000,000 to $10,000,000, this general principle of 1 per cent. increase on every additional $5,000,000 to be the fixed rate of inheritance and legacy tax.

For example, on an estate valued at $20,000,000 the tax would be as follows:

$1,000,000, 1 per cent	$10,000
4,000,000, 2 per cent	80,000
5,000,000, 3 per cent	150,000
5,000,000, 4 per cent	200,000
5,000,000, 5 per cent	250,000
$20,000,000	$690,000

The succession tax is founded on the broadest principles of equity. I maintain that the wealth possessed by every individual has been created directly or indirectly by the help of others, and therefore he owes to others, or, generally speaking, to the public, obligations which he ought to repay.

This is particularly true in the United States. Every citizen, whether he be rich or poor, is equal in the eye of the law, and has behind him, for the protection of his rights, the entire power of the nation. It is, therefore, no more than just that every person who accumulates property should pay for the protection that the State secures to him and his possessions.

If each State were to establish a tax on legacies and inheritances, such as just proposed, and devote the money so obtained to the construction and maintenance of roads, in a few years the older and more populous States would be provided with roads equal to those of England, France and Switzerland, and good roads, when rightly con-

structed, can be maintained at comparatively small cost, and, as the wealth of the States increased, the succession tax would furnish sufficient revenue to meet all the expenses of the State after paying for the maintenance of roads, thus relieving the people from all direct taxation for State purposes.

THE PLAN IN QUEENS COUNTY, NEW YORK, FOR BUILDING ROADS.

JAMAICA, N. Y., October 24th, 1898.

Henry I. Budd, Esq., Commissioner of Public Roads, Trenton, N. J.:

DEAR SIR—In answer to your communication asking for a brief description of our method of construction, &c, I will say our roads are classified to meet the probable traffic. The lightest roads we use are constructed of four inches of stone spread loosely, and the heaviest are roads eight inches in thickness in the center and six inches at the sides. Between these two classes we use various thicknesses, generally making the road heavier at the crown than at the sides. Our minimum width is fifteen feet. The widths are varied from fifteen feet to the entire width of the roadway, the latter being the practice for the construction of village streets. The general width used in this county for main thoroughfares is eighteen feet.

We have not established any maximum gradient. All of our roads are carefully graded, and a reasonable time allowed for settlement before the application of stone. We pay a good deal of attention to the construction of the trench. We remove unfit material to the necessary depths and refill with a mixture of sandy loam. The trench is always thoroughly rolled.

Our lighter roads are built in one course, but our eight-inch roads are built in two courses, the lower of which is three inches in thickness, of stone from two to three inches in size, sufficiently filled with good sharp sand. The top course is constructed of trap-rock. This course is five inches in thickness at the crown and three inches at the sides. This course is rolled without the application of any filler or water until the stone is properly compacted. Finely-screened sharp sand is then used as a filler up to within one-half inch of the top surface of the course. Fine screenings are then added in sufficient quantity to bring out evenly with the top course. We then apply the water to prove that the filling has been completed.

Upon the surface of this course, while it is moist, we spread a light coating of clay, with screenings and coarse sand thoroughly wetted and rolled down.

The stone used in the top course varies in size from two and one-half inches to one and one-half inches, containing not more than one-third of the extreme of either size.

Under no circumstances do we follow the practice of introducing any materials of a *loamy* or *clayey* nature between the particles of stone.

Yours very truly,

JOHN J. MCLAUGHLIN,
Engineer Queens County, Long Island, N. Y.

HOW ROADS ARE MADE IN FLUSHING, LONG ISLAND.

After the bottom is roughly shaped, it is rolled with a steam-roller until all settling ceases, after which it is brought to the exact form desired, and re-rolled if necessary. Wherever the soil proves spongy or otherwise unsuitable as a foundation, it is removed and the space filled with sand. Where shifting bottoms are encountered, a layer of about three inches of tailings is laid, rolled to a bearing and bound with sand. In one-half the roadbed the central portion is formed to an elevation of four inches over the remaining portion.

Over the surface thus prepared, the road metal is spread by being thrown broadcast from shovels so as to thoroughly mix the sizes. The trap-rock, ranging in size from one inch to two inches, is laid to a thickness of seven inches at the crown of the road and at a point midway between the center and sides, and four and a half inches at the sides.

A ten-ton steam-roller is then passed over the material until all the "creeping" of the stone ceases, after which the binding material, in the shape of clean, coarse sand, is applied gradually as the rolling progresses, and thoroughly washed in, after which coarse screenings are added in small quantities and the rolling and sprinkling continued until the water flushes freely before the roller. Over this surface a thin layer of sand is cast, and after being allowed to dry, the road is opened to travel.

The streets constructed with but four inches of road metal, treated as previously described, have been in use over two years. Several of these streets have been subjected, temporarily, to extremely heavy traffic without the slightest injury. Neither have they been affected in the least by extremely severe winters.

These roads have no top-dressing other than a thin layer of coarse sand, which is renewed as it wears away. Special attention is given to the drainage of the surface and the roadbeds are frequently cleaned. Depressions, wherever they do occur, are attended to at once; the surface is loosened by picking, and only enough stone is spread to fairly fill the depression; the patch is then covered with coarse sand and screenings. These streets being regularly sprinkled, drivers of sprinkling wagons are directed to wet the repaired spots freely and, under the action of traffic, consolidation is speedly effected,

hence repairs are possible even during the dryest seasons. But very little such patching has been necessary so far.

To all the improved streets almost every day such attention is given as they may require. If mud accumulates in some shaded spot it is removed; sand is strewn on spots that are too bare; stone is added wherever needed. It is found that one man with a horse and cart can readily take care of about five miles of streets. This system of permanent maintenance produces a more uniformly satisfactory condition than periodical attendance.

Reference has previously been made to sand as a binding material. No claim is made that it makes a better or more lasting road than screenings. It has one advantage, and that is that it makes a somewhat cleaner road and one that dries more quickly. In Flushing, sand is considerably cheaper than screenings, a purely local advantage which induced its use.

The maintenance of these roads has been extremely inexpensive, and consists in sweeping and in maintaining a thin wearing surface by the occasional spreading of a small amount of gravelly sand.

MANNER OF CONSTRUCTING ROADS IN BRIDGEPORT, CONN.

"In building these roads the ground is graded. The soil is then thoroughly rolled with a fifteen-ton roller and the stone spread on the surface so prepared. Underdraining has in no case been resorted to, an eighteen-inch gutter being sufficient. After broken trap-rock is rolled to a bearing, screenings are added as a binder, and the road metal is well and thoroughly filled with them, the whole being rolled until the water flushes to the surface. A strong silicious sand is sometimes used in place of these screenings. No loam or clay is used as a binder or filler, in construction or repair, unless a small spot is to be mended, too small to bring out the roller, then a little is used on the top of the broken stone while the traffic is consolidating it. The points in the construction of these roads which should be emphasized are: First, thoroughly compacting the soil before the broken stone is applied; second, clean binding, which should offer as great or greater resistance to crushing as the stone itself; third, use a steam-roller of competent weight; fourth, the combination of these two in connection with sufficient skill resulting in a wheelway that is without spaces in its lower surface to invite percolation of mud from

below; that is sufficiently compact to shed rain; and has some cohesive strength, while the clean binding which is strenuously insisted on prevents movements of the stones among themselves and keeps their angles from wearing off."

MASSACHUSETTS ROAD CONSTRUCTION.

The following is a condensed description of the rules governing the construction of Massachusetts' stone roads:

Where all trap-rock is used the bottom course is made of stone 1¼ to 2½ inches; the top course, 1½ to 1¼ inches. Where the foundation is good and no telford is required, the bottom course is 4 inches thick at the center and 3 inches thick at the sides after rolling; the top course, 2 inches thick after rolling. Where telford is used the bottom course of small stone must be 2½ inches thick after rolling; the top course, 1½ inches thick after rolling. The binder course in all cases must only be sufficient to cover the coarser stone after rolling. Each course of broken stone must be rolled separately, and evened up with stone of the same sizes as have been used in that particular course. When possible, roll the sub-grade with a steam roller. If the sub-grade is too sandy to roll, cover with coarse gravel laid on to a depth of three inches, or as much more as may be needed to give a good foundation. Fill any depressions with the same material until the surface is true and even. All broken stone must be rolled.

After spreading the first course of broken stone, begin rolling at the sides and continue this by running ahead so as to allow from two to five inches of the driving wheel to pass over the shoulder, and backward with the outer edge of the driving wheel from five to ten inches inside of the edge of the broken stone. Roll until the stone ceases to wave in front of the wheels, and until it seems formed under foot as you walk over it. Next begin on the other side and roll in the same manner, then work towards the center until the stone is rolled. Roll each layer of stone in the same manner; if the road shows a wavy motion after passing the roller over it three or four times, it may indicate too much moisture in the sub-grade. If, on examination, you find this to be true, stop rolling and move ahead, allowing time for the sub-grade to dry out before spreading any broken stone. Great care must be taken to have the sub-grade carefully shaped and thoroughly compacted. All shoulders must be shaped

and left sufficiently high to roll to the proper grade before any broken stone is spread on the road.

Use water only on the top or binder course. Wet the binder course thoroughly before rolling, but not to the extent of saturating the foundation. Apply the water and allow it to settle down below the top surface before passing the roller over it. Too much water, or too little, will give trouble by causing the surface to be picked up. Must not, under any conditions, roll the screenings while dry. Must not allow teams to pass over the road after the screenings are spread before the rolling is done. The rolling must be begun as soon as the road is wet, and continue until the section covered with screenings is thoroughly compacted.

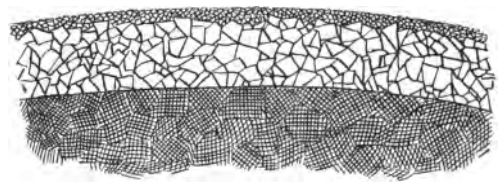
In telfording, the telford stone shall be placed by hand vertically on the broadest edges and lengthwise across the road, so as to form a close, firm pavement. They shall be bound by inserting and driving down, in all places where it is practicable, stone of the proper size and shape to wedge them in their proper position. No large stone should be left with a projecting point coming nearer than four inches to the finished grade and cross section. If any such projection be found, it can be broken off to allow an equal depth of four inches of broken stone.

Roll the telfording with a steam roller until the surface is true and even, and four inches below the finished grade and cross-section.

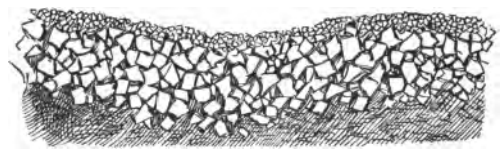
Stone on a macadam road as it appears when spread ready for rolling.

Stone on a macadam road when partially rolled, showing how the roller packs it.

Stone on a macadam road, firmly wedged and packed together. Small stones, gravel, dirt or sand if mixed with the stone or spread at the surface before rolling, prevent its being thoroughly wedged and packed.



A good foundation is necessary for a good macadam road. Both the foundation and the finished macadam roadway should be "crowned," or made higher in the middle than at the sides.



The mistake is often made of depositing macadam stone on an old road without first preparing a suitable foundation. This picture shows how the dirt or mud prevents the stone from becoming properly packed. The almost certain result is that the stone will continue to sink as the result of travel, while the mud oozes out at the top, leaving the road nearly as bad as before.

ROAD-BUILDING.

BY JAMES OWEN, C.E.

Before the Am. Soc. C. E., September 21st, 1898.

The question of road construction in latter years has assumed a somewhat different aspect from that which it bore some five or six years ago, when the subject was rather thoroughly discussed by the members of this society.

Attention should be called to what may be termed the competition in the road question as evidenced by the lowering of the prices for ordinary street pavements. The speaker remembers the time when the cost of building a telford pavement was about $2 per yard. To-day asphalt pavements are being built at a cost of about $1.38 per yard, and the engineer, in selecting a pavement, if he has any discretion in selecting, might suggest to his clients that it might be better in many places to choose a permanent street pavement, at the lower price which it now costs, than an ordinary macadam road. This idea is advanced because it seems to solve a good many problems. The construction of macadam or telford roads extends through different territories and different kinds of population and can be divided into what may be called mural, suburban and rural. Now, each of these kinds of road requires, to a certain extent, a special treatment, so far as construction for the travel and the available funds with which to construct them are concerned, and it seems to the speaker that it would probably be better to confine the discussion to rural roads, because in the future more permanent and less destructible pavements will be substituted in a great many cases where macadam would now be built.

There are two points to which attention should now be called—first, the material, and second, the hauling and laying of the material. Some years ago the speaker read a paper before this society and stated that he did not believe in thin pavements or in anything but a telford

pavement, as far as macadam was concerned, in ordinary circumstances. His mind has not very materially changed in this respect and he still adheres to the principle, both in theory and practice.

Mr. Leutze states that he put down an eight-inch macadam road. The speaker hardly thinks this is a wise practice, and believes that a road would be cheaper, very serviceable and would give better results if five inches of telford and three inches of macadam were used instead of eight inches of macadam only. In the first place, in most parts of the country there is available local stone, which is not perishable, which can be used for a foundation, leaving only the final finish of three inches to be provided from other sources. In the speaker's opinion, it is cheaper, in the majority of cases, to build an eight-inch or a ten-inch telford than an eight-inch macadam, and the final results are much better.

The next problem is the question of the selection of stone. It is conceded on all hands that trap-rock is the *sine qua non* for macadam and telford pavements. There are different kinds of trap-rock, and they work differently in treatment, but it probably will be agreed by all that a trap-rock pavement, if it can be built as cheaply, or even at a slightly greater cost than other stone, is the best. Certain country roads built with granite of rather a soft quality have been examined by the speaker, which, for the use to which they are put, are quite successful. A well-selected granite in one or two respects is preferable to trap; it is more friable, and, though it wears out a little faster, it does not break up in dry weather, and where it can be had with a short haul there is no specific objection to it. Of course, granite containing too much mica will not be successful.

In a limestone country, if properly handled, properly laid and judiciously finished, successful results can be had with a good limestone road. Its defects are known. It grinds out easier than either trap or granite. It is dusty. It is also known that a limestone road is much preferable to any other construction except either trap or granite.

Then there is the local use of the shales and gravels without treatment. Construction of a permanent gravel road on an aboriginal granite foundation can hardly be classified as an engineering improvement in the way of roads. Yet the proper use of gravel, carefully handled, thoroughly rolled and well selected, can make a very satisfactory road for Mr. North's suggestion of nine months in the year, but not for more than nine months. There are also the shales, which

can be treated and make really a better road for nine months in the year than limestone.

In naming these materials, nearly all the material for roads in this section of the country has been exhausted. In the Southern States there are other materials. In Tennessee there is an excellent natural material that makes fair traveling roads; and, of course, in the South, roads are not so apt to be broken up by frost, and all the care necessary, is to keep the water away and keep them from washing out.

In regard to the size of the stone, the speaker some years ago laid down as a principle that all stone for roads should pass through a one-and-three-quarter or one-and-a-half-inch ring. He has modified this view, having found that the locality of the roads should be considered, and now he classifies the sizes of the stone according to the character of the travel. While a very satisfactory driving road can be secured from one-and-a-half-inch stone for ordinary country travel, and for nice driving travel in a suburban community, the same cannot be said where travel is heavily congested; and, of late years in his practice, the size has been increased to from two to three inches, not only on the score of economy, but to secure better results and a better and more uniform surface; while, by the abandonment of the ideal one-and-a-half-inch stone, the smooth surface is sacrificed, a generally better average result is obtained by the use of the larger stone. It does not do to have the sizes mixed. If a road is built with two-and-a-half-inch or three-inch stone, it should all be two and a half inches or three inches—no dust, no small stone intermixed. If on a road there is a patch of two-inch stone, and then beyond that a little patch of one-and-a-half-inch, the latter will wear out more quickly than the former, and in a year or two there will be an uneven surface which should be avoided. The speaker wishes here to emphasize this point to those who manage the industry, in which a large amount of capital is invested, of breaking stone for the market. The difficulty is that in the arrangement of the crackers and the adjustment of the screens sufficient consideration is not given to separating the uniform sizes of stone to be delivered. The men who handle the stone-crackers and stone-breakers are too apt to dump it in a heap, and if two-inch stone is asked for, the answer is: "We will give you a little finer, but it doesn't hurt." It does hurt. The use of anything but uniform sizes is a material drawback to the final success of the road. If engineers will insist on that point, the result

on the wear and tear of the roads will be much more satisfactory not only to the engineer but to the community.

The question of the top-finishing of the road is a matter about which the speaker is not particularly solicitous. The top-finishing of a road is an accessory. If on a heavily-traveled road a coating of dust is placed, it probably will last from one to three months, after which the travel is down on the hard wearing surface below. In roads that are constructed for fancy driving dust is a very pleasant accessory and is desirable on that account; on a rarely-traveled country road it is very desirable because it prevents the breaking up of the stone surface below in dry weather and, to a certain extent, prevents wash in very wet weather. Generally speaking, however, the question of the dust is not of importance. A suggestion, however, has been made that a mixture of the trap-rock as the ideal stone and the limestone, which has a better cementing power, might be advisable.

Another point of which mention might be made is a much controverted question—the packing; that is, the injection of extraneous matter with the stone for the purpose of binding. This packing is nothing but a temporary expedient to get the road down to its permanent condition, and, as such, is a detail of construction and not a permanent factor in the wear and tear of the road. A great deal of controversy has arisen as to whether gravel, sand, clay or loam is the best material for packing. In the speaker's experience almost any available material, carefully selected, will do the work required of it. Gravel or sand may be used, but the speaker does not recommend either. Clay should be used very sparingly. Ordinary earth, or loam, as it is called here, is about the most efficacious material to use for the purpose of getting a road down speedily. *Clay is treacherous.* The speaker has known a piece of road to be utterly ruined by an overdose of clay in its construction. It breaks the road up continuously, and the damage is never rectified until another coating is put on to eliminate the original error. It is merely a question of judgment on the part of the engineer as to how he will use packing, and in using that judgment the element of weather is the most important consideration, outside of the question of the character of the stone itself. A hard Orange Mountain stone needs a great deal more packing to get it down than does the Bergen trap-stone, and a Bergen trap-stone needs a great deal more than granite. The granite wants

very little. The limestone wants hardly any at all. The shale furnishes its own packing. But, going back to the point mentioned, the weather is an important consideration in this item of packing—not only the weather as it is to-day, but the probable weather conditions that may exist in the two or three months before the road is finally consolidated. If a period of dry weather can be anticipated, it is reasonable and desirable that a great deal more packing should be used than if the road is built late in the fall, when there is a prospect of wet weather ahead. In the latter case packing should be used very sparingly. It is entirely a matter of experience and judgment. If care is used in the selection and application of the packing, a great deal of the trouble that engineers find in building roads throughout the country, and the criticisms made that the packing should not be there, does not belong there, and that it is a fraud on the part of the contractor to put it there, will be eliminated.

The speaker has known whole communities torn to pieces on the question of packing, and governing bodies indicted on the question, simply because the public mind was not educated as to what was proper practice at that place and time.

HORSELESS CARRIAGES.

Inventor Edison believes that before long there will be a horseless carriage on the market that can be sold for $100 at the most. That there would be a tremendous demand for such a vehicle goes without saying. Much as wheelmen pretend to like the exercise, there is not a bicycle rider in the world who would not trade off his machine for one that would go without leg-power, if the thing were possible.

The horseless wagon is surely coming. An "electric phaeton" was successfully tested at Hartford; a carriage with a kerosene motor had a satisfactory trial at Middletown. "It weighs," we are told, "only 620 pounds, and the cost is $1,500. Mr. Whitney, the inventor, gave several of the prominent residents of the city a ride, and the wagon went up the steep hills of the city as quickly as it passed over the macadamized principal thoroughfares." The cost of running the vehicle is said to be two cents a mile. Its speed is from ten to fifteen miles an hour.

The horseless carriage has become a positive craze in Paris, and its prospects in New York are brightening.

Mr. O. H. P. Belmont "ran" two automobiles at Newport this summer, one of them a single-seated carriage, something like a Stanhope, and the other for four persons. Other automobiles enlivened the Newport roads also. Mr. Barber had a double-seated one at Ardsley, where he and his automobile were the center of a good deal of interest. There are several horseless carriages in New York owned and operated by women. One woman said: "I should prefer an automobile to a horse because the electric cars have made driving so dangerous. The horse will run away, but the automobile cannot."

While the automobile in Paris has become the plaything of the rich and a dictator of fashions, in New York it has had a much less picturesque career, taking the delivery wagon form. In Paris it is a test of ultra-fashionableness. One of the American manufacturers has brought out a motor carrier as a rival to the large wagon. These will cost about $500 and will carry 500 pounds, and can be run at a cost of half a cent a mile. The same firm has compiled some rather interesting statistics as to the relative expense of motor delivery wagons and those drawn by horses.

They estimate that a regular delivery wagon costs $380, the two horses $250, and the harness $75, making a total of $705. The electric wagon they put down at $2,050. They figure the annual expenses as follows: For the horse wagon—interest on investment, $35.25; stabling two horses at $18.25 each per month, $438; shoeing, $30; harness repairs, $20; total, $523.25. For the electric carriage—interest on investment, $102.50; cost of electric current for 12,000 miles a year, $300; total, $402.50. This is the cost of the current if taken from a supply wire. If the owner of the wagon has his own dynamo, the cost of the current is only $20 a year, bringing the annual expense down to $122.50. The statistician ingeniously omits any charges for repairs to the electric carriage.

One significant fact which shows how times are changing is the announcement of a dealer in both bicycles and automobiles. He has for several years carried on a bicycle "riding academy." The present outlook has made him decide to discontinue the riding school entirely and use the entire floor space for an exhibit of horseless carriages.

FOR SETTLING DUST.

Crude petroleum has been used with good effect to suppress dust on railroad beds. Now it is advocated as a good application for country roads. It is claimed that by excluding water it keeps the road good in wet and dry weather. It will suppress dust and render the water cart unnecessary, and it prevents the formation of mud in winter.

GRAVEL PITS IN NEW JERSEY USED FOR ROAD-BUILDING.

Atlantic, Cumberland, Cape May, Camden, Gloucester and Ocean counties have numerous rich, ferruginous deposits of gravel, which are largely used in improving their local roads. They answer a very good purpose when the beds to be covered are sandy, and when the traffic is not heavy.

BURLINGTON COUNTY.

Pits.	Owners.	P. O. Address.
Riverton gravel	Lewis Connor	Riverton, N. J.
Westfield gravel	Enoch Evans	Westfield, N. J.
Lippincott gravel	Wm. R. Lippincott's estate	Westfield, N. J.
Evaul gravel	Isaac Evaul	Palmyra, N. J.
Morgan gravel	Wm. F. Morgan	Palmyra, N. J.
Hunter gravel	Franklin T. Hunter	Riverton, N. J.
Brock gravel	Edwin M. Brock	Bridgeboro, N. J.
Collins gravel	John S Collins	Moorestown, N. J.
Warrick gravel	John Warrick	Hartford, N. J.
Stokes gravel	James W. Stokes	Rancocas, N. J.
Bunting gravel	Thomas A. Bunting	Columbus, N. J.
Rogers gravel	Thomas H. Rogers	Columbus, N. J.
Kinsley gravel	C. G. Kinsley	Kinkora, N. J.
Wilson gravel	Edward Wilson	Columbus, N. J.
Sharp gravel	Charles Sharp	Columbus, N. J.
Bowne gravel	George Bowne	Florence, N. J.
Garnee gravel	Garnee estate	Jacksonville, N. J.
Hutchinson gravel	John B. Hutchinson	Georgetown, N. J.
Black gravel	Charles Black	Jobstown, N. J.
Austin gravel	Allen Austin	Centerton, N. J.
Buzby gravel	Mrs. John Buzby	Willingboro, N. J.
Coomb gravel	J. H. Coomb	Beverly, N. J.
Johnson gravel	Samuel Johnson	Burlington, N. J.
Baggs gravel	William Baggs	Beverly, N. J.
Fenimore gravel	Joshua Fenimore	Beverly, N. J.

MIDDLESEX COUNTY.

Pits.	Owners.	P. O. Address.
Herbert's	I. Biddle Herbert	Old Bridge, N. J.
Helmetta	Geo. W. Helme	Helmetta, N. J.
Jamesburg	James Buckelew's Sons	Jamesburg, N. J.
Englishtown	Chas. Hoffman	Englishtown, N. J.

Trap outcrops to a small extent in Middlesex county.

MONMOUTH COUNTY.

Pits.	Owners.	P. O. Address.
Shark River gravel	S. B. Oviatt	Asbury Park, N. J.
Allenwood gravel	George Potts	Ocean Grove, N. J.
Swan gravel	Webster Swan	Navesink, N. J.
Crawford gravel		Holmdel, N. J.
Keyport gravel		Keyport, N. J.
Red Bank gravel		Red Bank, N. J.

OCEAN COUNTY.

Pits.	Owners.	P. O. Address.
Lakewood gravel	Wm. Harrison	Lakewood, N. J.
Sherman gravel	John Sherman	Lakewood, N. J.
Staffordville gravel	Staffordville Gravel Co	Staffordville, N. J.

Berkeley, Manchester, Plumstead, Jackson, Ocean, Union, Eagleswood and Little Egg Harbor townships all have good gravel.

QUARRIES IN NEW JERSEY PRODUCING ROAD METAL.

Bergen and Hunterdon counties have numerous quarries, the names of which we have not succeeded in obtaining.

ESSEX COUNTY.

Owners.	Location.	Address.
Osborn & Marcellis	Montclair, N. J	Montclair, N. J.
F. J. Marley	Montclair, N. J	Little Falls, N. J.
Wright & Lindsley	Orange, N J	Orange, N. J.
George Spottiswoode & Co.	Orange, N. J.	Orange, N. J.
C. A. Lighthipe & Son	Millburn, N. J.	Millburn, N. J.

HUDSON COUNTY.

Quarry.	Owners.	P. O. Address.
Bergen Hill	B. M. & J. F. Shanley	Newark, N. J.
Palisade Construction Co.		1 Montgomery St., Jersey City, N. J.
Hudson County Contracting Co.		267 Communipaw Ave., Jersey City, N. J.

HUNTERDON COUNTY.

Quarry.	Owners.	P. O. Address.
Berger's	M. F. Berger	Byram Station, N. J.
Shanley's	B. M. & J. F. Shanley	Byram Station, N. J.

MERCER COUNTY.

Quarry.	Owners.	P. O. Address.
Moore's	Delaware River Q. & Cons. Co.	Lambertville, N. J.
Lambertville	Barbour & Ireland	1241 Filbert St., Phila.
Goat Hill	B. M. & J. F. Shanley	14 S. Broad St, Phila.
Hopewell	Hopewell Quarry Co	Hopewell, N. J.

MORRIS COUNTY.

Nearly all road-building material in this county is of native rock, gneiss, granite and shale. The traps are mostly imported from other counties.

PASSAIC COUNTY.

Location.	Owners.	P. O. Address.
Cedar Grove	Francisco Bros	Cedar Grove, N. J.
Cedar Grove	Francis Marley	Little Falls, N. J.
Paterson	Berger & Wolf	Paterson, N. J.
Paterson	E. T. Galloway	Paterson, N. J.
Paterson	McKiernan & Bergen	Paterson, N. J.
Notch Road	Francis Marley	Little Falls, N. J.
Notch Road	Edward Dowling	Notch Road, N. J.
Haledon	R. M. Torbet	Haledon, N. J.
Hawthorne	Daniel & D. Stanley	Hawthorne, N. J.
Preakness	Colfax & Steele	Preakness, N. J.
Paterson	Munson & Co	Rockaway, N. J.

SOMERSET COUNTY.

Quarry.	Owners.	P. O. Address.
Wilson's	James Wilson	Dunellen, N. J.
Smalley's	A. I. & N. B. Smalley	North Plainfield, N. J.
Morris County Crushed Stone Co., Millington	Fred. W. Schmidt	Morristown, N. J.
Chimney Rock	William Haelig.	Bound Brook, N. J.
Hillpot's	J. E. Hillpot	Bound Brook, N. J.
Hardgrove's	William Hardgrove	Somerville, N. J.
Rocky Hill Stone Storage Co	Fred De Coppet, Supt	Rocky Hill, N. J.
Bernardsville	Frank S. Tainter	Morristown, N. J.
Schley's (private)	Grant Schley	Far Hills, N. J.
Mine Brook Stone Co.	McCollum & Freeman	Bernardsville, N. J.

SUSSEX COUNTY.

Quarry.	Owner.	P. O. Address.
Newton State Quarry	David B. Hetzel, Attorney	Newton, N. J.

UNION COUNTY.

Quarry.	Owner.	P. O. Address.
Wilson	Howard S. Wilson	Plainfield, N. J.

Extensive bodies of trap in Union county, but few quarries. Have been able to secure the name and locality of but one.

Dover Road, at Junction Colonia Road, Middlesex Co., N. J. Before.

Dover Road, at Junction Colonia Road, Middlesex Co., N. J. After.

STATEMENTS BY ENGINEERS AND SUPERVISORS.

Mr. Henry I. Budd, State Commissioner of Public Roads, Trenton, N. J.:

DEAR SIR—Below find an exact detailed statement of the cost of the Egg Harbor City and Mays Landing road, townships of Hamilton and Egg Harbor, county of Atlantic, State of New Jersey. Total length, 36,120 feet, or 6.84 miles.

Width of gravel-bed, 14 feet.
Depth of gravel-bed, 8 and 6 inches.
Length of gravel-bed, 36,120 feet.

Preliminary survey	$95 56
Printing	24 60
Preparation of roadbed (cost)	2,842 37
Cost of gravel (balance donated)	3 60
Committee expenses	176 33
Gravel, extra deep	20 00
Gravel, 10,934 $\frac{7}{27}$ cubic yards, at 31 cents	3,389 61
Earth excavation, 1,448.2 cubic yards, at 20 cents	289 64
Stripping gravel, 5,403.9 cubic yards, at 15 cents	810 58
Overhaulage, per cubic yard, at 20 cents each half mile	3,810 80
Open ditches, at 15 cents per cubic yard	74 16
Supervisor's salary	453 00
Engineering expenses	328 97
Total	$12,319 22

Maximum grade before	5.43
Maximum grade now	2.10

We hereby certify the above statement to be correct.

Respectfully yours,

J. J. ALBERTSON,
Engineer.

W. H. BURGESS,
Supervisor.

Mr. Henry I. Budd, State Commissioner of Public Roads, Trenton, N. J.:

DEAR SIR—Below find an exact detailed statement of the cost of the London Bridge road, city of Burlington, county of Burlington, State of New Jersey. Total length, 3,882 feet, or about three-fourths mile.

Width of stone-bed, 16 feet.
Depth of stone-bed, 8 inches.
Length of stone-bed, 3,882 feet.
Number of tons of stone used in construction, 2,725.

Macadam, 6,900 square yards, at 54⅛ cents	$3,737 50
Eight hundred cubic yards extra fill, at 51½ cents	412 00
Earth excavation, 780 cubic yards, at 25⅛ cents	196 56
Terra cotta pipe, 30 lineal feet, at 12½ cents	3 75
Supervisor's salary	87 00
Engineering expenses	86 98
Total	$4,523 79

Maximum grade before	4%
Maximum grade now	1%

We hereby certify the above statement to be correct.

Respectfully yours,
HENRY S. HAINES,
Engineer.
W. H. ADAMS,
Supervisor.

Mr. Henry I. Budd, State Commissioner of Public Roads, Trenton, N. J.:

DEAR SIR—Below find an exact detailed statement of the cost of the Brown's Mill to Lisbon road, township of Pemberton, county of Burlington, State of New Jersey. Total length, 14,488 feet, or 2$\frac{488}{880}$ miles.

Width of stone-bed, 10 feet.
Depth of stone-bed, 6 inches.
Length of stone-bed, 14,488 feet.

Macadam, 16,098 square yards, at 54 cents	$8,692 92
Supervisor's salary	128 00
Engineering expenses	175 31
Total	$8,996 23

Maximum grade before	4½%
Maximum grade now	3½%

We hereby certify the above statement to be correct.

Respectfully yours,
FRANK EARL,
Engineer.
JOHN N. SMITH,
Snpervisor.

Mr. Henry I. Budd, State Commissioner of Public Roads, Trenton, N. J.:

DEAR SIR—Below find an exact detailed statement of the cost of the Pemberton to Lisbon road, township and borough of Pemberton, county of Burlington, State of New Jersey. Total length, 14,178 feet—10 feet wide, } or $3\frac{2121}{5280}$ miles.
" " 3,954 " 16 " " }

NOTE—The borough, in addition to above, has done 5,689.75 square yards, at 57 cents. Cost, $3,243.15.

Width of stone-bed, 16 and 10 feet.
Depth of stone-bed, 6 inches.
Length of stone bed, 18,132 feet.

Macadam, 22,783 square yards, at 57 cents	$12,986 31
Earth excavation, 450 cubic yards, at 25 cents	112 50
Supervisor's salary	256 00
Engineering expenses	264 29
Total	$13,619 10
Maximum grade before	4½ %
Maximum grade now	3½ %

We hereby certify the above statement to be correct.

Respectfully yours,

FRANK EARL,
Engineer.

JOHN N. SMITH,
Supervisor.

Mr. Henry I. Budd, State Commissioner of Public Roads, Trenton, N. J.:

DEAR SIR—Below find an exact detailed statement of the cost of the Riverton and Riverside road, townships of Riverside and Cinnaminson, county of Burlington, State of New Jersey. Total length, 17,920 feet, or $3\frac{1}{3}$ miles.

Width of stone-bed, 12 feet.
Depth of stone-bed, 8 inches.
Length of stone-bed, 17,920 feet.

Macadam, 24,022⅔ square yards, at 67 cents	$16.095 29
Gravel, 1,200 cubic yards, included in above cost.	
Earth excavation, 14,782 cubic yards, included in above cost.	
Supervisor's salary	471 00
Engineering expenses	323 10
Total	$16,889 39
Maximum grade before	24 inches to 100 feet.
Maximum grade now	6 inches to 100 feet.

We hereby certify the above statement to be correct.

Respectfully yours,

HOWARD PARRY,
Engineer.

JOEL HORNER,
Supervisor.

Mr. Henry I. Budd, State Commissioner of Public Roads, Trenton, N. J.:

DEAR SIR—Below find an exact detailed statement of the cost of the Columbus and Chambers Corner road, townships of Mansfield and Springfield, county of Burlington, State of New Jersey. Total length, 20,100 feet, or $3\frac{7}{11}$ miles.

Width of stone-bed, 10 feet.
Depth of stone-bed, 8 inches.
Length of stone-bed, 20,100 feet.

Number of tons of stone used in construction	9,400
Macadam, 22,665⅓ square yards, at 74 cents	$16,772 35
Supervisor's salary	459 00
Engineering expenses	346 62
Total	$17,577 97

Maximum grade before	7%
Maximum grade now	5%

We hereby certify the above statement to be correct.

Respectfully yours,
PETER E. HARVEY,
Engineer.
C. CRAIG TALLMAN,
Supervisor.

Mr. Henry I. Budd, State Commissioner of Public Roads, Trenton, N. J.:

DEAR SIR—Below find an exact detailed statement of the cost of the Waterford road, townships of Waterford and Winslow, county of Camden, State of New Jersey. Total length, 58,700 feet, or 11.12 miles.

Width of gravel-bed, 14 feet.
Depth of gravel-bed, 8 and 6 inches.
Length of gravel-bed, 58,700 feet.

Preparation of roadbed (cost)	$3,815 50
Grubbing road, 17.16 acres, at $17	291 72
Stripping gravel pits, 18,267.8 cubic yards, at 15 cents	2,740 17
Gravel, 17,912.87 square yards, at 26¾ cents	4,791 69
Earth excavation, 8,303.6 cubic yards, at 22 cents	1,826 79
Gravel, extra deep	27 67
Overhaulage	4,668 47
Open ditches, 3,719.89 cubic yards, at 12 cents	446 39
Tile drain, 442 lineal feet, at 18 cents	79 56
Supervisor's salary	648 00
Engineering expenses	522 85
Total	$19,858 81

Maximum grade before, per 100 feet, was..... 5.80 feet.
Maximum grade now per 100 feet, is..... 1.80 feet.

We hereby certify the above statement to be correct.

Respectfully yours,
J. J. ALBERTSON,
Engineer.
J. E. ALBERTSON,
Supervisor.

Mr. Henry I. Budd, State Commissioner of Public Roads, Trenton, N. J.:

DEAR SIR—Below find an exact detailed statement of the cost of Kaighn's avenue road, township of Stockton, city of Camden, county of Camden, State of New Jersey. Total length, 8,831 feet, or 1.67 miles.

Width of stone-bed, 14 feet.
Depth of stone-bed, 10 inches.
Length of stone-bed, 8,831 feet.
Number of tons of stone used in construction, about 5,999.

Macadam, 6,707⅔ square yards, at 68 cents.....	$4,560 56
Telford, 7,127 square yards, at 68 cents.....	4,846 36
Earth excavation, 1,850 cubic yards, at 24 cents.....	444 00
Cobble gutters, 484 88 square yards, at 50 cents.....	242 44
Tile drain, 609 lineal feet, at 17 cents.....	103 53
Supervisor's salary.....	286 50
Engineering expenses.....	305 92
Total.....	$10,789 65

Maximum grade before..... 8.66 per 100 feet.
Maximum grade now..... 2.70 per 100 feet.

We hereby certify the above statement to be correct.

Respectfully yours,
J. J. ALBERTSON,
Engineer.
WILLIAM C. WOOD,
Supervisor.

Mr. Henry I. Budd, State Commissioner of Public Roads, Trenton, N. J.:

DEAR SIR—Below find an exact detailed statement of the cost of Walnut street road, township of Livingston, county of Essex, State of New Jersey. Total length, 6,605 feet, or 1.23 miles.

Width of stone-bed, 14 feet.
Depth of stone-bed, 8 inches.
Length of stone-bed, 6,605 feet.

Telford, 10,386 square yards, at 42 cents.....	$4,362 12
Earth excavation, 8,595 cubic yards, at 20 cents.....	1,719 00
Drain, 400 lineal feet, at 15 cents.....	60 00
Total.....	$6,141 12

Maximum grade before..... 5.80 feet in 100.
Maximum grade now..... 2.87 feet in 100.

We hereby certify the above statement to be correct.

Respectfully yours,

JAMES OWEN,
Engineer.
JOHN C. WILLIAMS,
Supervisor.

Mr. Henry I. Budd, State Commissioner of Public Roads, Trenton, N. J.:

DEAR SIR—Below find an exact detailed statement of the cost of Grove street road, town of Montclair, county of Essex, State of New Jersey. Total length, 13,611 feet, or $2\frac{3}{5}$ miles.

Width of stone-bed, 16 feet.
Depth of stone-bed, 8 inches.
Length of stone-bed, 13,611 feet.

Telford, 24,217 square yards, at 43 cents	$10,413 31
Earth excavation, 18,583 cubic yards, at 22 cents	4,088 26
Total	$14,501 57

Maximum grade before..... 4.2 feet in 100.
Maximum grade now..... 3.1 feet in 100.

We hereby certify the above statement to be correct.

Respectfully yours,

JAMES OWEN,
Engineer.
HENRY SPEER,
Supervisor.

Mr. Henry I. Budd, State Commissioner of Public Roads, Trenton, N. J.:

DEAR SIR—Below find an exact detailed statement of the cost of the Grove avenue road, township of Verona, county of Essex, State of New Jersey. Total length, 9,792 feet, or $1\frac{7}{10}$ miles.

Width of stone-bed, 16 feet.
Depth of stone-bed, 8 inches.
Length of stone-bed, 9,792 feet.

Telford, 17,472 square yards, at 34 cents	$5,940 48
Earth excavation, 16,396 cubic yards, at 24 cents	3,935 04
Total	$9,875 52

Maximum grade before..... 7.01 feet in 100.
Maximum grade now..... 3.37 feet in 100.

We hereby certify the above statement to be correct.

Respectfully yours,

JAMES OWEN,
Engineer.
J. J. THATCHER,
Supervisor.

Mr. Henry I. Budd, State Commissioner of Public Roads, Trenton, N. J.:

DEAR SIR—Below find an exact detailed statement of the cost of Franklin avenue, township of Bloomfield, county of Essex, State of New Jersey. It is partly constructed, the remaining portion to be completed and paid for in 1899. Total length, 528 feet, or one-tenth of a mile.

Width of stone-bed, 16 feet.
Depth of stone-bed, 8 inches.
Length of stone-bed, 528 feet.

Total	$663 75

Maximum grade before	13.8 feet in 100.
Maximum grade now	5.2 feet in 100.

We hereby certify the above statement to be correct.

Respectfully yours,
JAMES OWEN,
Engineer.
JACOB TROUTFETTER,
Supervisor.

Mr. Henry I. Budd, State Commissioner of Public Roads, Trenton, N. J.:

DEAR SIR—Below find an exact detailed statement of the cost of South Orange avenue, townships of Millburn and Livingston, county of Essex, State of New Jersey. Total length, 18,035 feet, or 3.41 miles.

Width of stone-bed, 14 feet.
Depth of stone-bed, 8 inches.

Telford, 28,197 square yards, at 40 cents	$11,278 80
Earth excavation, 31,128 cubic yards, at 25 cents	7,782 00
Drain, 1,000 lineal feet, at 15 cents	150 00
Total	$19,210 80

Maximum grade before	12.95 feet per 100.
Maximum grade now	7.83 feet per 100.

We hereby certify the above statement to be correct.

Respectfully yours,
JAMES OWEN,
Engineer.
THEO. B. HUFF,
Supervisor.

Mr. Henry I. Budd, State Commissioner of Public Roads, Trenton, N. J.:

DEAR SIR—Below find an exact detailed statement of the cost of the Asbury road, Paulsboro to Swedesboro, townships of Greenwich, Logan and Woolwich, county of Gloucester, State of New Jersey. Total length, 40,069.5 feet, including bridges, or 7.59 miles.

Width of stone-bed, 3,306 feet, 16 feet wide, and 36,669.15 feet, 10 feet wide.
Depth of stone-bed, eight inches.
Length of stone-bed, 39,975.15 feet.
Number of tons of stone used in construction, 13,723.013.
Preparation of roadbed (cost) included in bid per square yard for macadam.

Macadam, 46,620.833 square yards, at 64 cents	$29,837 33
Macadam, 180.737 square yards extra, put on roadbed on account of settling of roadbed across meadow bottom, which could not be brought up with three-quarter-inch stone and screenings, as some settled as much as ten inches, and wings at Swedesboro end	115 67
Earth excavation, 1,127.70 cubic yards, at 25 cents	281 92
Tile drain, 725 lineal feet, at 10 cents	72 50
Supervisor's salary, 159 days, at $3	477 00
Engineering expenses	606 14
Total	$31,390 56
Maximum grade before	5½%
Maximum grade now	3½%

We hereby certify the above statement to be correct.

Respectfully yours,
WM. M. CARTER,
Engineer.
JAMES B. COOPER,
Supervisor.

Mr. Henry I. Budd, State Commissioner of Public Roads, Trenton, N. J.:

DEAR SIR—Below find an exact detailed statement of the cost of the White Horse road, township of Hamilton and city of Trenton, county of Mercer, State of New Jersey. Total length, 11,955 feet, or $2\frac{99}{151}$ miles.

Width of stone-bed, 44 and 16 feet.
Depth of stone-bed, 4 and 6 inches.
Length of stone-bed, 11,955 feet.

Macadam, 24,616 square yards 4-inch, 15,005 square yards 6-inch Earth excavation, 14,978 cubic yards	$17,900 00
Pipe drain, as per agreement	227 99
Supervisor's salary	357 00
Engineering expenses	517 20
Total	$19,002 19
Maximum grade before	.0240
Maximum grade now	.0171

We hereby certify the above statement to be correct.

Respectfully yours,
FRANK J. EPPELE,
Engineer.
EUGENE S. WILLEY,
Supervisor.

Mr. Henry I. Budd, State Commissioner of Public Roads, Trenton, N. J.:

DEAR SIR—Below find an exact detailed statement of the cost of the White Horse Road extension, township of Hamilton, county of Mercer, State of New Jersey. Total length, 2,313 feet.

Width of stone-bed, 12 feet.
Depth of stone-bed, 6 and 8 inches.
Length of stone-bed, 2,313 feet.

Macadam, 534 square yards 6-inch, 2,554 square yards 8-inch Earth excavation, 5,498 cubic yards.....	$2,475 00
Tile drain, 658 lineal feet, at 12 cents.....	78 96
Supervisor's salary.....	150 00
Engineering expenses.....	70 13

EXTRAS.

Twenty-one square yards cobble gutter.....	10 50
Cross drains and inlets as per agreement.....	200 00
Iron railing on wing walls of bridge.....	14 40
Iron pipe in front of church.....	26 50
Total.....	$3,025 49

Maximum grade before.....	.091
Maximum grade now.....	.056

We hereby certify the above statement to be correct.

Respectfully yours,
FRANK J. EPPELE,
Engineer.
EUGENE S. WILLEY,
Supervisor.

Mr Henry I. Budd, State Commissioner of Public Roads, Trenton, N. J.:

DEAR SIR—Below find an exact detailed statement of the cost of the Middlesex avenue extension road, township of Woodbridge, county of Middlesex, State of New Jersey. Total length, 5,627 feet, or $1\frac{8}{10}$ miles.

Width of stone-bed, 12 feet.
Depth of stone-bed, 8 inches.
Length of stone-bed, 5,627 feet.

Macadam, 7,503 square yards.

Lump sum.....	$4,900 00
Extra work.....	3 12
Supervisor's salary.....	315 00
Engineering expenses.....	98 06
Total.....	$5,316 18

Maximum grade before	7%
Maximum grade now	4%

We hereby certify the above statement to be correct.

Respectfully yours,
R. J. DOUGHERTY,
Engineer.
JOHN CORREJA, Jr.,
Supervisor.

Mr. Henry I. Budd, State Commissioner of Public Roads, Trenton, N. J.:

Dear Sir—Below find an exact detailed statement of the cost of the Metuchen and Menlo Park road, township of Raritan, county of Middlesex, State of New Jersey. Total length, 11,497 feet, or $2\frac{2}{10}$ miles.

Width of stone-bed, 12 feet.
Depth of stone-bed, 8 inches.
Length of stone-bed, 11,497 feet.

Macadam, 15,347 square yards.
Earth excavation, 5,105 cubic yards.

Lump sum	$9,400 00
Approaches, extra macadam	267 15
Extra work	784 17
Supervisor's salary	468 00
Engineering expenses	203 68
Total	$11,123 00

Maximum grade before	7%
Maximum grade now	4%

We hereby certify the above statement to be correct.

Respectfully yours,
R. J. DOUGHERTY,
Engineer.
WILLIAM CARMAN,
Supervisor.

Mr. Henry I. Budd, State Commissioner of Public Roads, Trenton, N. J.:

Dear Sir—Below find an exact detailed statement of the cost of the Menlo Park and Iselin extension road, township of Woodbridge, county of Middlesex, State of New Jersey. Total length, 6,267 feet, or $1\frac{987}{2180}$ miles.

Width of stone-bed, 12 feet.
Depth of stone-bed, 8 inches.
Length of stone-bed, 6,267 feet.

Macadam, 8,360 square yards.
Earth excavation, 2,009 cubic yards.

Lump sum	$4,995 00
Supervisor's salary	183 00
Engineering expenses	99 90
Total	$5,277 90

Maximum grade before	4%
Maximum grade now	3%

We hereby certify the above statement to be correct.

Respectfully yours,

R. J. DOUGHERTY,
Engineer.

JOHN CORREJA, JR.,
Supervisor.

Mr. Henry I Budd, State Commissioner of Public Roads, Trenton, N. J :

DEAR SIR—Below find an exact detailed statement of the cost of the Colonia road, township of Woodbridge, county of Middlesex, State of New Jersey. Total length, 9,141 feet, or $1\frac{8}{32}\frac{1}{0}$ miles.

Width of stone-bed, 12 feet.
Depth of stone-bed, 8 inches.
Length of stone-bed, 9,141 feet.

Preparation of road-bed (cost), lump sum	$7,600 00
Extra fill	50 00
Supervisor's salary	399 00
Engineering expenses	153 60
Total	$8,202 00

Maximum grade before	3½%
Maximum grade now	1½%

We hereby certify the above statement to be correct.

Respectfully yours,

R. J. DOUGHERTY,
Engineer.

E. G. CONE,
Supervisor.

Mr. Henry I. Budd, State Commissioner of Public Roads, Trenton, N. J.:

DEAR SIR—We herewith submit a detailed statement of the cost of the Baird road, leading from Manalapan to Baird post-office, in Millstone township, Monmouth county. Total length of line, 7,871 lineal feet.

Width of gravel roadway, 12 feet.
Depth of compacted gravel, 8 inches.

BILL OF COST.

Preparation of roadbed, 7,871 lineal feet, at 5 cents	$393 55
$2,332\frac{4}{7}$ cubic yards compacted gravel in roadway, at 63 cents	1,469 25
140 cubic yards compacted extra gravel for Y at Manalapan, at 63 cents, to connect with ore road to widen pavement at the Manalapan church and cemetery, and at Mount's, including the removal of stone wall at Mount's ($5)	93 20
3,794 cubic yards earth excavation, at 21 cents	796 74
166 cubic yards stripping gravel beds	24 90

815 cubic yards overhaul of gravel over one mile, at 18 cents	$146 70
197 cubic yards overhaul of gravel over two miles, at 36 cents	70 92
Supervisor's salary	250 00
Engineer's salary, including compensation of rodmen and chainmen	215 00
Total	$3,460 26

Dated November 1st, 1898.

PETER FORMAN,
Engineer.
CHARLES A. BAIRD,
Supervisor.

Mr. Henry I. Budd, State Commissioner of Public Roads, Trenton, N. J.:

DEAR SIR—We herewith submit a detailed statement of the cost of the Perrineville road leading from Perrineville post-office to the Mercer county line, in Millstone township, Monmouth county, constructed of iron ore and gravel. Total length of line, 19,098 lineal feet.

Width of pavement, 12 feet.
Total depth of pavement, 7 inches.
Compacted iron ore, first course, 4 inches.
Compacted gravel, second course and facing, 3 inches.

ITEMS OF COST.

25,464 square yards of finished roadway, iron ore and gravel, per specifications, at 27¾ cents	$7,066 26
1,907 lineal feet of tile drain, at 9¾ cents	185 93
2,251 cubic yards earth excavation, at 21¾ cents	489 59
1,975 cubic yards filling and winging not found on road, per specifications, at 26¾ cents	528 31
Supervisor's salary	390 00
Rodmen and chainmen	29 96
Engineer's salary	310 00
Total	$9,000 00

Dated November 1st, 1898.

PETER FORMAN,
Engineer.
CHARLES L. IRWIN
Supervisor.

Mr. Henry I. Budd, State Commissioner of Public Roads, Trenton, N. J.:

DEAR SIR—Below find an exact detailed statement of the cost of Ridgedale avenue, township of Chatham, county of Morris, State of New Jersey. Total length, 8,172 feet, or $1\frac{372}{500}$ miles.

Width of stone-bed, 12 feet.
Depth of stone-bed, 6 inches
Length of stone-bed, 8,172 feet.

Macadam, 10,896 square yards, at 42 cents	$4,576 32
Macadam, 2,166 square yards, extra depth and width, at 42 cents	909 72
Earth excavation, 2,733 cubic yards, at 20 cents	546 60
Rock excavation, 1 cubic yard, at 95 cents	95
Twenty-seven lineal feet, iron 12-inch pipe, at $1.60	43 20
Stone drain, 85 lineal feet, at 20 cents	17 00
Supervisor's salary	192 00
Engineering expenses	267 88
Total	$6,553 67
Maximum grade before	7%
Maximum grade now	4.5%

We hereby certify the above statement to be correct.

Respectfully yours,

WILLIAM E. KING,
County Engineer.

WILLIAM F. HANCOCK.
Supervisor.

Mr. Henry I Budd, State Commissioner of Public Roads, Trenton, N. J.:

DEAR SIR—Below find an exact detailed statement of the cost of the Basking Ridge road, townships of Morris and Passaic, county of Morris, State of New Jersey. Total length, 25,092 feet, or 4.75 miles.

Width of stone-bed, 12 feet.
Depth of stone-bed, 6 inches.
Length of stone-bed, 25,092 feet.

Macadam, 33,456 square yards, at 48 cents	$16,058 88
Iron drain-pipe, 1,346 lineal feet, at $1.20	1,615 20
Earth excavation, 11,559 cubic yards, at 25 cents	2,889 75
Rock excavation, 196 cubic yards, at $1	196 00
Overhaulage, 600 feet, at 6 cents	36 00
Stone drain, 17,112 lineal feet, at 10 cents	171 12
Supervisor's salary	261 00
Engineering expenses	636 47
Total	$21,864 42
Maximum grade before	10.7%
Maximum grade now	6.0%

We hereby certify the above statement to be correct.

Respectfully yours,

WILLIAM E. KING,
Engineer.

D. I. PRUDDEN,
Supervisor.

Mr. Henry I. Budd, State Commissioner of Public Roads, Trenton, N. J.:

DEAR SIR—The grading and macadamizing of the Paterson and Hamburg turnpike, from where the present macadam ends to the line in said turnpike dividing Passaic and Morris counties, in the township of West Milford, is finished, and the following is a true statement of the work done and the cost thereof:

30,502 square yards macadam, at 19½ cents per square yard	$5,947 89
15,529.25 cubic yards earth excavation, at 16 cents per cubic yard	2,484 68
3,842.5 cubic yards solid rock, at 66 cents per cubic yard	2,536 05
15,529.25 cubic yards loose rock, at 17 cents per cubic yard	2,639 97
506.93 cubic yards dry wall, at 90 cents per cubic yard	456 23
3 catch-basins, at $3 each	9 00
90 lineal feet 18-inch cast-iron pipe, at $1 40 per lineal foot	126 00
270 lineal feet 12-inch cast-iron pipe, at 95 cents per lineal foot	256 50
6 cubic yards rubble masonry, at $1.25 per cubic yard	7 50
1,265 square yards paving gutters with cobblestones, at 30 cents per square yard	379 50
7,213 square yards bottom stone, at 25 cents per square yard	1,810 75
Total	$16,654 07

WILLIAM H. CISCO,
Supervisor.
WILLIAM L. WHITMORE,
County Engineer, Passaic County.

Mr. Henry I. Budd, State Commissioner of Public Roads, Trenton, N. J.:

DEAR SIR—The grading and macadamizing of Lafayette avenue, from the Wagaraw road to Rea avenue, in the township of Manchester, is finished, and the following is a true statement of the work done and the cost thereof:

11,370 square yards 4-inch macadam, at 24 cents per square yard	$2,728 80
40.79 lineal feet 10-inch cast-iron pipe, at $1 per lineal foot	40 79
1,872 square yards cobblestone paving, at 60 cents per square yard	1,123 20
Total	$3,892 79

WILLIAM L. WHITMORE,
County Engineer.

Mr. Henry I. Budd, State Commissioner of Public Roads, Trenton, N. J.:

DEAR SIR—The grading and macadamizing of Ramapo avenue, from the Paterson and Hamburg turnpike to Lakeside avenue, in the borough of Pompton Lakes, is finished, and the following is a true statement of the work done and the cost thereof:

4,741 square yards 4-inch macadam at 23½ cents per square yard	$1,114 14
Earth excavation	25 00
Total	$1,139 14

JOHN J. BARTHOLF,
Supervisor.
WILLIAM L. WHITMORE,
County Engineer, Passaic County.

Mr. Henry I. Budd, State Commissioner of Public Roads, Trenton, N. J.:

DEAR SIR—The grading and macadamizing of Fifth avenue, from Crooks avenue to a point 75 feet south of South Second street, in the township of Acquackanonk, is finished, and the following is a true statement of the work done and the cost thereof:

1,100 square yards 4-inch macadam at 37 cents per square yard..... $407 00

WILLIAM L. WHITMORE,
County Engineer.

Mr. Henry I. Budd, State Commissioner of Public Roads, Trenton, N. J.:

DEAR SIR—Below find an exact detailed statement of the cost of the Harlingen and Belle Mead road, townships of Hillsborough and Montgomery, county of Somerset, State of New Jersey. Total length, 23,225 feet, or 4.36 miles.

Width of stone-bed, 12 and 10 feet.
Depth of stone-bed, 10 inches
Length of stone-bed, 23,225 feet.

Rock, 28,061.33 square yards, at 52 cents	$14,591 89
Overhaulage	200 00
Tile drain, 5,200 lineal feet, at 10 cents	520 00
Supervisor's salary	381 00
Engineering expenses	874 95
Total	$16,567 84
Maximum grade before	7.04%
Maximum grade now	4.82%

We hereby certify the above statement to be correct.

Respectfully yours,
JOSHUA DOUGHTY, JR.,
Engineer.
ERNEST C. TAGGART,
Supervisor.

Mr. Henry I. Budd, State Commissioner of Public Roads, Trenton, N. J.:

DEAR SIR—Below find an exact detailed statement of the cost of the South Somerville road, township of Bridgewater, county of Somerset, State of New Jersey. Total length, 15,425 feet, or 2.9 miles.

Width of stone-bed, 12 feet.
Depth of stone-bed, 9 inches and 12 inches.
Length of stone-bed, 15,125 feet; 300 feet less for bridge.

Macadam, 13,233.6 square yards, at 48 cents	$6,352 13
Telford, 6,933.3 square yards, at 54 cents	3,743 98
Extra macadam	180 00

Earth excavation, 8,813 cubic yards.

Ditching, 1,657.5 feet, at 10 cents	$165 75
Tile drain, 5,100 lineal feet, at 10 cents	510 00
Supervisor's salary	342 00
Engineering expenses	467 35
Total	$11,761 21
Maximum grade before	7.00%
Maximum grade now	5.34%

We hereby certify the above statement to be correct

Respectfully yours,

JOSHUA DOUGHTY, JR.,
Engineer.

HIRAM ROCKAFELLOW,
Supervisor.

Kaighn's Ave., Camden Co., N. J. Before.

Kaighn's Ave., Camden Co., N. J. After.

OPINIONS OF REPRESENTATIVE CITIZENS ABOUT STATE AID FOR HARD ROADS.

CINNAMINSON, N. J., Sept. 24th, 1898.

Mr. Henry I. Budd, State Commissioner of Public Roads, Trenton, N. J.:

DEAR SIR—The State Aid Road law has grown in popular favor year by year ever since its enactment.

Those who, at first, deemed it a cumbersome, visionary theory, owing to the diversity of interests represented in the cost of construction of the roads, now find after years of observation, that there is no friction between the parties concerned, and that in practice everything works out harmoniously, and, instead of being opponents of the system, as at the beginning, they are now earnest advocates of it.

Some others argue that while in their judgment the act might be amended with evident advantage to all concerned by requesting the townships through which the road to be improved runs, to share in the cost of its construction, they heartily indorse the plan of the State and county joining in the work.

Without State aid there are several rural townships in the State which could not enjoy the benefits of an improved road, as the cost of construction would place upon them a burden they could not bear.

Experience has shown that when townships are required to build their own roads, they subdivide the work to such an extent by putting it upon the road districts, that it finally results in the abutting property-owners being compelled to build the roads themselves or let them go unimproved. In the first case all the people of the State are privileged to use a road, toward the expense of which they have borne no share, while the owner of the property, and the builder of the road, may be so situated as not to be able to enjoy the benefits of his own expenditures. In the latter case the road remains unimproved, and the property-owner may suffer no greater loss or inconvenience than his fellow-citizens.

By having good roads the farmer is enabled to deliver the products of his farm to the consumer, whether he reside in a village or in the larger cities, at much less cost than he could do upon bad roads, and thus these citizens are compensated, in the reduced cost of the necessaries of life, for their contributions in the way of taxation toward the construction of the country roads.

There has been a perceptible gain in the management of our stone roads. Those who have the supervision of repairs understand their work better than at the first. We see less of the raveling of the surface stone than formerly, and then, too, the introduction of broad tires has had a wonderful effect in the preservation of the roads. There would be a great advantage in having the wagon-tires still wider, say six

inches, and having the front axle eight inches shorter than the rear one, so the wheels would not follow in the same tracks. These reforms might be introduced by an amendment to the Broad-tire act by offering a greater rebate from taxation for these special features of wagon construction.

Notwithstanding the favorable comments of the State Aid law above mentioned, there is an incongruous element which mars the whole work in the estimation of many of our people. I allude to the toll-roads in this part of the State. These corporations were granted franchises to build improved roads long before the State Aid law was enacted. In their day and generation they served the purpose for which they were created. They were the pioneers of road improvement in their vicinity; they were object-lessons for the education of the people of New Jersey to a higher standard of excellence in road-making. And now the citizens of these very sections of the State who were instrumental in having these roads constructed at their own expense for the State and counties, and who would not at that time have entertained for a moment a proposition to build them, have a penalty inflicted upon them for their enterprise and public spirit, in being required to maintain by tolls their leading highways; also by contributions in the way of taxation to the construction and maintenance of other roads for the use and benefit of their competitors in business. These tolls amount to from fifty to two hundred dollars per year each to many farmers—sufficient to constitute to themselves a nice profit, in these days of sharp competition, on the business transacted.

The State of New Jersey certainly does not desire to discriminate against any portion of her citizens, particularly those who have paved the way for a higher prosperity.

Some historians claim that the degeneracy of Spain is due to the fact that enterprise was frowned down and public spirit among her citizens was crushed out. Let not New Jersey follow in her footsteps.

Very respectfully,

CLAYTON CONROW,
President N. J. State Road Improvement Association.

MOORESTOWN, N. J., October 25th, 1898.

Mr. Henry I. Budd, State Commissioner of Public Roads, Trenton, N. J.:

DEAR SIR—The township of Chester, county of Burlington, in which I live, has long been interested in improved roads, and we now have about fifteen miles of telford and macadam, out of a total of forty miles. About ten miles have been down six or seven years and were paid for by the township, and have given excellent service and satisfaction during all that period with very moderate outlay for repairs. These fifteen miles being the most important roads, except our turnpikes, and having a good, firm surface at all seasons of the year, doubtless carry two-thirds of the whole travel of our township system not carried by the toll roads.

We are learning to build and maintain good roads at a less cost each year, and I am sure the expenditures for them are among the most conspicuously beneficial outlays the State and counties are called upon to make.

In figuring up the actual cost, at present prices, of macadam or telford roads in average portions of our State, I find that if the cost of construction and maintenance were added together, and were then placed as a toll on all the travel upon these roads, that the rate on each wagon would be less than one-quarter cent per mile, instead of the usual charge on good turnpiks of one and one-half cents per mile.

We would have the additional advantages of avoiding the nuisance of stopping daily to pay tolls, of carrying double loads on all such roads in case of heavy hauling, and of higher speed and greater comfort in driving and bicycling.

With other incidental advantages of importance, it is no wonder that everyone that examines into the matter is in favor of good roads, and that the State appropriation is so inadequate to carry on the construction of the mileage that is yearly demanded.

It is doubtful if any other public expenditure will pay so good a dividend to our people upon so small an investment as the money used in building and keeping in order permanent roadways throughout our State, when such highways are important thoroughfares.

Very truly,

SAMUEL L. ALLEN.

CAMDEN, N. J., Oct. 13th, 1898.

Mr. Henry I. Budd, State Commissioner of Public Roads, Trenton, N. J.:

DEAR SIR—So far as my observation goes, the sentiment of the public in both Camden and Burlington counties, in both of which I am materially interested, is in favor of the extension of good roads under the State Aid act, and, in my judgment, it would be wise for the State to increase the appropriations for this purpose, as far as is consistent with the requirements of the State in other directions

There can be no question that good roads are an important and essential factor in the development of the State, and therefore the improvement in this line should be carried steadily forward.

Very respectfully,

ALEX. C. WOOD.

RIVERTON, N. J., Sept. 20th, 1898.

Mr. Henry I. Budd, State Commissioner of Public Roads, Trenton, N. J.:

DEAR SIR—The people of this section are very much in favor of the improved roads built by State aid. I think the desire of the people generally is that they may be extended as rapidly as can be done without increasing our taxes too much. They feel that they derive some benefit from good roads, while there is but little to show for the public money expended in many other directions. The farmers have generally adopted the broad tires for their wagons that are steadily on the roads. Other heavy wagons (such as oil tanks) should be compelled to do the same. The demand here is almost universal for free roads, and we feel that the pikes should be taken under State and county control as quickly as possible.

While we are in favor of well-graded roads, we prefer to see them thoroughly well built rather than to have them put down at railroad grade at excessive cost. It has been stated as a fact that in stage-coach days the horses that showed signs of breaking down on the level roads were shifted to the more hilly portions of the route.

The new road from Riverton to Riverside, now nearly finished, has been a great boon to the laboring people, both men and women, as anyone traveling on the cars morning and evening must have observed. We farmers have to keep well over to the right, off the middle of the road, to avoid the bicyclers during that time of the day.

Respectfully yours,

HOWARD G. TAYLOR.

CHATHAM, N. J.

Mr. Henry I. Budd, State Commissioner of Public Roads, Trenton, N. J.:

DEAR SIR—I inclose description of plan for guarding against a macadam road built with a thinner layer of stone than the specifications call for. It will also lessen the liability of having too much clay or "packing" thrown on the road at the time it is built.

Contractors generally seem to think it their privilege to economize in crushed stone by using a great deal more clay than is required for the good of the road. I have observed roads in different localities, that had been built by different contractors, that appeared all right as long as the weather kept comparatively dry, yet in the rainy season or during a thaw they would exude a coating of clay fully two inches deep. The clay while in a soft or pulpy state had been pressed, by the ordinary travel, from the interstices between the stones. Of course the stone must have settled in like proportion, leaving only four inches of macadam where it had before been six inches.

As there is no way of measuring the amount of packing, the engineer or supervisor could only object in useless and unpleasant argument with the contractor.

Not intending to cast any reflections upon any contractor in particular, but accepting human nature as we find it, I am led, by careful observation, to believe that the public on an average pay for one-fourth more crushed stone in building new roads than they really get.

As a remedy I submit the inclosed plan, with the suggestion that the contractor be informed that the road will be tested for depth of stone just before the reserved payment is to be made, and a proportionate deduction be made for any failure to hold up to full measure.

Wire cloth is very cheap, and a strip six inches to a foot wide, along the center of the road, would probably be enough. It could be unrolled just ahead of the stone and in that way would not be liable to injury by being driven over.

The new road here has already proved its usefulness far beyond its cost. It is no unusual sight to see a number of heavy wagons with loads of freight, averaging from one to three tons each, following close behind the other at a good trot. It looked odd at first, as it had always been customary for them to move at a snail's pace over the old dirt road.

Yours sincerely,

WILLIAM E. BUDD.

FELLOWSHIP, N. J., Oct. 3d, 1898.

Mr. Henry I. Budd, State Commissioner of Public Roads, Trenton, N. J.:

DEAR SIR—If we can estimate the public appreciation of stone roads by the increase of travel over them, we feel safe in saying that these roads are growing more and more in favor every year.

Great care, however, will have to be exercised that these public highways do not become neglected, and gradually wear away under continued heavy carting, almost too great for stone to stand, and only continual vigilance on the part of those having charge of these great thoroughfares will prevent this evil.

Very truly yours,

WILLIAM R. LIPPINCOTT.

Mr. Henry I. Budd, State Commissioner of Public Roads, Trenton. N. J.:

DEAR SIR—I am very much interested in road improvements. I was Chairman of the Township Committee of Ridgewood, Bergen county, a few years ago, when we spent over $30,000 for macadamized roads.

Ridgewood was the first town in the western part of Bergen county to lay macadam. Its action and example were followed by Orvil, Midland and Saddle River. We have some of the best roads in the western part of the county, and are in hopes to have more in a few years. If you could impress upon township officials the necessity for laying macadam with more care, it would have a tendency to insure the construction of better roads in the future than we have had in the past. Township officials ought to supervise their work more than they do and watch contractors at all points. They ought to see that the roadbed is properly prepared and rolled before the first coating of broken stone is laid. The public ought to be excluded from roads which are being macadamized until they are completed.

Not enough attention is paid to wetting and rolling. Contractors, because in some cases it is difficult to get water, try to make township officials believe that a large amount of water is not necessary. I do not believe it is possible too get too much water on a new macadamized road or to roll it too much, and I doubt if it is possible to use too heavy a roller. I am inclined to think that a twenty-ton roller would do better work than a ten or twelve-ton roller. A twelve-ton roller will make a good road, however, if it is used enough.

We have had some poor roads laid in the western part of our county, owing to the lack of such supervision as I have suggested above.

Yours truly,

M. T. RICHARDSON,
No. 27 Park Place, New York.

UPPER MONTCLAIR, N. J.

Mr. Henry I. Budd, State Commissioner of Public Roads, Trenton, N. J.:

DEAR SIR—Your annual report came duly to hand, for which accept thanks.

Although we have built a good many miles of road under our close personal supervision, we are always glad to carefully read and learn all we can of the observation of others.

There is probably no part of macadam road construction more important than the rolling. All through your report you speak of the necessity of thoroughly compacting the road, and on page 36 you speak of the evil effects of forming a crust of screenings. In these matters we most thoroughly agree with you, but your advocating a heavy steam roller does not, in our opinion, produce the desired result, and does have the effect of producing the crust objected to. It is far more economical to the contractor to use a steam roller. The crust or apparently finished roadway is quickly attained, but not a thoroughly compacted road. A body of loose stone as spread upon the roadbed will support a very heavy weight, particularly if it is spread over the wide surface such as covered by the wide tread and large diameter of a steam roller without compacting it in every part.

A horse roller of not over three feet in width and thirty inches in diameter, and weighing from two to three tons, is not heavy enough to produce the objectionable

surface-rolling, but rather has a tendency to jar or shake each individual stone to its proper bed.

This process is not economical to the contractor, but if such a roller is used on each course of stone until the surface is hard, you can feel assured that all possible voids are filled.

In looking over roads which have been in use for a few years, we find that roads built with a steam roller show more weak spots than those upon which lighter rollers have been used.

As the question of maintenance is quite as important an item as the original construction, it should have equal consideration.

The above remarks are the result of personal observation, and not the reports of foremen or persons who have any interest in selling any particular kind of roller.

If you have any information that would lead us to a contrary opinion, we should be glad to receive the same. Such information would be valueless if coming from parties interested in steam rollers, or contractors whose sole idea is to get work done as cheaply as possible.

During the past season the writer laid the road from Mount Tabor to Morris Plains. It was a six-inch macadam, all of Millington trap-rock. Three such rollers as we advocate were kept going day and night, the amount of finished work being about sixty lineal feet of twelve-foot roadway per roller for each working day of ten hours.

A steam roller could do from six to ten times as much, but we very much doubt if the quality of the work would be as enduring.

If you have any roads similar in width, grades and material, and subjected to about the same amount of wear, constructed about the same time, we should like to watch them and note their condition one or two years hence, and compare the relative qualities of steam and horse rolling.

While this letter may not meet your approval, we presume you desire to have the opinions and experiences of all sides, and therefore take the liberty of expressing ours.

Again thanking you for your courtesy, we remain,

Very truly yours,

OSBORNE & MARSELLIS.

HAMMONTON, N. J.

Mr. Henry I. Budd, State Commissioner of Public Roads, Trenton, N. J.:

DEAR SIR—Your fourth annual report received, for which accept thanks. I appreciate it very much, as I take a great interest in good roads and wide-tread wagons. I have been using four-inch tread wagons for about five years, and am now hauling green cedar logs a distance of about 4½ miles, and hauling a cord and over at a load, which weighs from 4,000 to 4,200 pounds to the cord. When we used two-inch tread wagons, about five-eighths of a cord made a load for a team.

In carting from Hammonton to Egg Harbor formerly 2,000 to 2,500 pounds made a load. Since the new road was built we take 6,000 and more with less fatigue to the teams, and in much less time. We also do a great deal more business with the towns along the good roads than before they were built.

Truly yours,

WILLIAM BERNSHOUSE.

RARITAN, N. J., Sept. 21st, 1898.

Mr. Henry I. Budd, State Commissioner of Public Roads, Trenton, N. J:

DEAR SIR—It is more than probable that Somerset county will take her full share of the State appropriation for some years to come.

Our ordinary dirt roads have been much improved in the last fifteen years by the general use of the road machines, and are in good condition on an average about ten months in the year. For ninety per cent. of the ordinary farm use we would prefer the dirt road to the stone during these months. Ten years ago, in District No. 7, Bridgewater township, we were ready to petition for a stone road. Since that time we have formed the roadbed with the road machine, and used the $40 appropriation to cart gravel two miles. This has reduced the bad season one-third, and gives a slight annual improvement—requires one-third extra work to equal the amount secured by the appropriation.

For example: Eighty loads gravel, at fifty cents, cost $40. One load covers 20 feet; eighty loads cover 1,600 lineal feet, about one-third of the road; the gravel wears out, so that one-third of the road needs the 20 feet per load coating every year, one-third every two years, while the remaining one-third would do well if coated every three years. To do this would require twice the appropriation to form the road and buy the gravel at ten cents per load. Cracked stone is not available for us, as it would cost delivered two and a half to three times as much as gravel.

My expression of a possible solution is this:

That the State, or State and county, or State, county and townships combine to make available at convenient distributing points, cracked stone of various sizes, with provision for automatic loading; that this stone be furnished free to anyone who will place it, under suitable restrictions, on any part of any public road.

This would work this way: Road districts like ours would use the cracked stone instead of gravel to a distance of, say, four miles plus the gravel distance, and for wet and springy spots to a distance of perhaps eight miles from the distributing points. Farmers who appreciated the benefit would, beginning slowly, use increasingly their teams when idle, to improve the weak points on their usual lines of travel. Old-fashioned frolics might come into play again. Enthusiastic bicyclers would exert a constant pressure in favor of the continued use of any means of distribution, and if this plan were once fairly tried, I do not think it would be given up.

A small appropriation from the State, county or township that would allow the payment of, say, fifteen cents per ton for the first mile, and eight cents per ton per mile thereafter, would cause a comparatively rapid distribution by farm teams when not busy at farm work, for it would give good wages to a man or an ambitious boy where he could use a team without extra cost, and would give a small farmer whose crops had failed an opportunity to secure part of his interest, and in some cases, I am sure, from past observation, would enable him to save his home until more prosperous times.

Another decided want that we roadmakers feel is that of a heavy roller. One or perhaps two in the larger townships would do the work that nothing else will do. The cost is far beyond the districts. The roller, like the stone, should be available to anyone who would use it carefully on the public road.

Yours respectfully,

PHILIP LINDSLEY.

PLAINFIELD, N. J., Sept. 28th, 1898.

Mr. Henry I. Budd, State Commissioner of Public Roads, Trenton, N. J.:

DEAR SIR—Stone roads are very popular in this section of the country, and continue to grow in favor with the people generally, and I have yet to hear of the first person that is now opposed to further State aid for that purpose.

Park avenue (as you may know) from Plainfield to Metuchen, was the first stone road made under the State law, and by actual count before and since the improvement, the travel has increased over fourfold.

Most of the stone for road improvement at Metuchen and beyond, goes over this road. Before it was macadamized, twenty-five to thirty hundred was a heavy haul for a good team; they now carry from three to four tons at a load, and do it with greater ease.

If the Legislature is in doubt as to the popularity of further road improvement, let it propose an increase of State aid, subject to a vote of the people, and I believe it would be carried by a very large majority; in this section I should say ten to one.

Truly yours,

MAHLON VAIL.

CAMDEN, N. J., Sept. 17th, 1898.

Mr. Henry I. Budd, State Commissioner of Public Roads, Trenton, N. J.:

DEAR SIR—We have observed that road-building, not alone for the past year but ever since it was instituted in the modern line, has the sentiment, not alone of those who, like us, having teams are naturally interested in good roads, but of the decent thinking part of the community.

In our line of business the advantage is particularly felt. Since the lumber business, by lack of over-building in our city, has spread and been done over the outlying sections almost entirely during the past six or seven years, long hauls have been necessitated, which could not have been accomplished without great disadvantage over the old style of road.

Respectfully yours,

SHIVERS & MOFFETT.

VINCENTOWN, N. J., Sept. 20th, 1898.

Mr. Henry I. Budd, State Commissioner of Public Roads, Trenton, N. J.:

DEAR SIR—The improved stone road system in this vicinity has revolutionized the farming interest. Before the road from Vincentown to Merchantville was built, the farmers for miles around did not grow anything for the Philadelphia market. Now easy access to this market has made us a trucking community. The land being good and adapted to the growth of fruits and vegetables, its productions have made quite an impression upon the markets in the cities of Camden and Philadelphia, the inhabitants being able to procure their vegetables and fruits at a much lower price. That is the way the taxpayers in the cities of the State get back their returns for their increased taxation for stone road improvement. The appropriation by the State seems too small for the benefit of the whole State, as most of the counties are waking up and asking for improved stone roads under State aid. I am not in favor of any one county progressing too much, as taxes are high enough according to the present prices of pro-

ducts. But when the State appropriation is divided between most of the counties, it leaves so small a share for each, that it is impossible for each county to build any appreciable length of road each year.

The people in this vicinity would not be willing to go back to the old road system since they have been favored with the improved stone roads.

I am in favor of the stone road law, yet I think there should be some way to cause the people who live adjacent to the property-holders abutting the line of the road, to pay part of the ten per cent.

Yours truly,
JOHN P. LIPPINCOTT.

WOODBURY, N. J., Sept. 17th, 1898.

Mr. Henry I. Budd, State Commissioner of Public Roads, Trenton, N. J:

DEAR SIR—In reply to yours of the 14th instant, would say that the prejudice existing against the construction of stone roads has to a large extent disappeared, and the prevailing idea now appears to be that the main or leading roads through the county should be improved under the State Aid act.

Persons situated within reach of the constructed roads perceive the benefit resulting by being able to move their produce with so much less "horse force," their teams being able to draw double the amount of load and at the same time keep in better condition. Our citizens of such parts of the county as are not yet enjoying the benefits of roads constructed under the State Aid act are becoming educated to the benefits derived; therefore demand that they too shall be entitled to consideration by having good roads constructed in their localities, thus giving them an opportunity to share in the benefits as well as the burdens of taxation.

There are many adherents to the theory that the turnpikes should be acquired by the State and county and made free roads, and they base their belief on just grounds. For instance, there are within our county farmers living along the line of turnpikes (toll roads) who are required to pay from fifty to eighty cents toll for one double team in order to place their load of produce in market, while a brother farmer, situated just as far from market, but five or ten miles across the country on or near a road improved under the State Aid act, is free from toll, and the former has to contribute, in addition to his toll, his share of the tax for the construction and maintenance of the road of which the latter has the free use.

Very truly yours,
WM. M. CARTER,
Engineer.

NEWARK, N. J., Sept. 17th, 1898.

Mr. Henry I. Budd, State Commissioner of Public Roads, Trenton, N. J.:

DEAR SIR—Various townships throughout Essex county have kept well to the front in adding to their good roads, which are being multiplied continually.

The sentiment of the people in city and county is heartily in favor of improvement in this direction, and this our principal city is fast being lifted out of the mud by fine pavements of asphalt, stone and brick. Outside of the cities telford or macadam is naturally in favor, and, if properly laid of our native trap-rock, answers a most excellent purpose.

In my judgment, legislation should be enacted regulating the width of the tires upon all vehicles intended to carry above a specified weight. This legislation should be so arranged that the change from the present to the legal width of tire would not be burdensome to anyone, and to take effect in one or two years from passage of act.

Trusting that we will take no steps backward in this very important matter, I am,

Yours very truly,

S. J. MEEKER.

OLD BRIDGE, N. J., Sept. 23d, 1898.

Mr. Henry I. Budd, State Commissioner of Public Roads, Trenton, N. J.:

DEAR SIR—The people of Madison township are unanimously in favor of an increased State road appropriation.

The expression of public opinion in the way of petitions for stone roads in our county, is proof positive to us that the State aid should be increased.

The roads built in Middlesex, under your approval, have been the means of educating the people of every township to the value of good roads and more of them.

Success to you for an increased appropriation.

Yours respectfully,

ASBURY FOUNTAIN.

NEWARK, N. J., Sept. 26th, 1898.

Mr. Henry I. Budd, State Commissioner of Public Roads, Trenton, N J.:

DEAR SIR—I have not heard of any change of sentiment as regards the desire for good roads or appropriating money for them. The townships, counties and cities make liberal appropriations for streets and roads, and there is no complaining, for we all realize it is one of the things that makes for our salvation.

Good roads have done wonders for this end of New Jersey, and as regards State appropriation, I have heard of no objection to it. Individually, I believe it is a good and proper thing to do. Some of the populous counties have already been helped by State aid to secure good roads. It would be selfish to shut down now and not give the back counties some benefit from this source. Making a piece of road in a county in the way adopted by the State is a very helpful object-lesson, and stimulates the people to make their by-roads good. Then I think the farming districts are justly entitled to a share of the large amount the State receives annually in taxes from corporations, riparian rights, &c. In various ways the State helps the town and city; let it also, in this public way, help the farming section.

I think I notice more disposition to grade the streets to the exact engineer's level than formerly. Before putting on macadam this is important. While simple macadam is laid in country districts and suburban towns, the cities are adopting on its level streets what is termed asphalt pavement. Many miles of it have been laid in Newark. After the street has been graded down to a sublevel and the ground rolled with a heavy roller, a concrete made of cement and two-inch broken stone, wet and thoroughly mixed, is laid six, eight or ten inches, as the street seems to demand. This is all gone over with hand-pounder to closely mass it together. It is then allowed to stand for a week to set and harden. On this a two-inch coat of binder, composed of one-inch broken stone and asphalt, is laid. This is rolled with a steam roller and then a final coat of pure sand and asphalt is put on the surface and rolled.

But very little crown is made. Where the grade is not steep and the traffic is not too heavy, it makes an excellent pavement, especially for residence streets. It is easily kept clean; it does not grind up like macadam, to form a dust and wash away; it is smooth and pleasant to walk on and noiseless to ride over; splendid for the bicycle, and a play-yard for children. Its disadvantage is, it is slippery for horses in wet and icy weather. Team horses cannot get the grip on it with their feet they can on block or macadam. It is also more costly.

Quite a number of streets are also laid with vitrified brick on a concrete foundation. This makes a smooth and very acceptable pavement. The city, upon application of property-owners, has the pavements laid, bonding the city to pay the contractor, and this gives the landowner five or six years to pay for it.

Yours truly,

DENNIS C. CRANE.

TRENTON, N. J., Sept. 20th, 1898.

Mr. Henry I. Budd, State Commissioner of Public Roads, Trenton, N. J.:

DEAR SIR—As a wheelman and officer of the greatest organization in the world, and as a business man having considerable connections with our farming citizens in this county, it would be difficult for me to say anything more expressive of the wishes of the people, than that they are continually petitioning for State aid in the construction of their roads, and are continually fighting to see if they can get a road in front of their farm first.

I think this of itself speaks volumes, and while it necessarily increases county taxes, still I am sure the more prudent and observing taxpayer makes little or no complaint, so long as the money is judiciously expended.

Very sincerely,

JAMES C. TATTERSALL,
Secretary-Treasurer of N. J. Division of Wheelman.

RIDGEFIELD, Bergen County, N. J., Sept. 24th, 1898.

Mr. Henry I. Budd, State Commissioner of Public Roads, Trenton, N. J.:

DEAR SIR—Replying to your favor of the 13th instant, asking information as to the prevailing sentiment in this neighborhood regarding the importance of improved highways, I may say that there is but one opinion upon that subject, and that is, good roads are absolutely indispensable for the prosperity and well-being of every rural community.

The attention of our people was called to the subject many years ago, and it has been an easy matter to keep it sufficiently alive to secure reasonable appropriations from year to year to macadamize nearly all the roads within the limit of this borough. The same thing may be said, I think, of most of the boroughs in east Bergen. Because they have taxed themselves for road improvements and built good roads, many feel disinclined to be taxed for road improvements in other parts of the State, as will be necessary if State aid is furnished. It was this agreement which induced Englewood's representatives last year to oppose the construction of a county road in the western part of the county. Nevertheless, I am of the opinion that a large majority of those interested in the subject in this part of Bergen county are in favor of State aid. Some people think it would be better to compel municipalities by law to

macadamize their roads at their own expense, as others have voluntarily done; but that is hardly practicable, and if it were, there would still remain provisions to be made in Bergen county for the more thorough and complete facilities for wagon traffic on the arteries diverging from Hudson county northward and westward.

All main wagon roads, as well as railroads, in this part of the State, lead to and from New York, and Bergen county east of Paterson has not a single one leading into Hudson county (which is the gateway to New York) that can be called first class. Three years ago Hudson county bonded herself to construct a magnificent driveway from Bergen Point to the Bergen county line, overlooking the valleys of the Passaic and Hackensack rivers. Not content with that, she last year extended this grand boulevard across the mountain and returned it along the easterly brow of the Palisades, overlooking the glorious Hudson and the great metropolis. This has practically brought Bergen county much nearer New York and gives an opportunity to the adjacent district, particularly the Palisade region, to derive an immense benefit through road improvement.

While the westerly boulevard was being constructed in Hudson county, an effort was made to extend it northward through Bergen county as far, at least, as Fort Lee. A desirable route was practically agreed upon, but the property-owners dreaded the thought of being assessed for the improvement, and the project was abandoned. It was then that the borough of Ridgefield, with a view of showing how practicable such a scheme was, and with the hope that the adjoining boroughs would, of their own motion, connect with and extend it, laid out a boulevard, eighty feet wide, on the proposed line, extending from its south to its north boundary, and worked in the center thereof a wagon road thirty feet wide. Up to the present time our hopes have not been realized. I mention this fact to show how earnest some people are, and how indifferent others are to road improvement. They are indifferent chiefly because they are not able, or think they are not, to stand assessments for anything not imperatively needed for their present use or comfort, and therefore would be found favoring State aid for main thoroughfares.

My own opinion is that State aid should be limited to the construction and maintenance of great thoroughfares connecting adjoining townships, and such grand driveways as the whole State might be interested in, as along the brows of the famous Palisades, for instance. But I think, nevertheless, that very liberal State aid for any and all road purposes, under regulations that would secure a just and equitable distribution of the funds, would be a great blessing.

Very respectfully yours,

ALEXANDER SHALER,
Pres't of Ridgefield Imp't Ass'n.

NEWFOUNDLAND, Passaic County, N. J., Sept. 17th, 1893.

Mr. Henry I. Budd, State Commissioner of Public Roads, Trenton, N. J.:

DEAR SIR—The road-building in this vicinity is giving great satisfaction to nine out of every ten taxpayers, and it is the greatest improvement this town ever had or ever will have. The only thing the people object to is the inability to get more road-building started in this vicinity. There has been a petition, signed by nine out of every ten taxpayers, for about three years, to have a certain road built, but the only reason given for not building same is that the State money has all been used, which I find is correct.

I think, like many other taxpayers around here, that the coming Legislature should increase the appropriations for improving roads.

Yours very truly,

C. J. NEWMAN.

Mr. Henry I. Budd, State Commissioner of Public Roads, Trenton, N. J:

DEAR SIR—The macadam roads in our borough, constructed two years, have proved a great success.

Our country roads, built in the same manner by the Board of Freeholders, are equally satisfactory, and our people are ready to meet any taxation for continued improvement in sparsely-settled districts.

It is hoped that no hesitation in our Legislature will prevent extended improvement throughout our entire State.

Dirt roads must go, and broad tires must be obligatory—by fines, if necessary.

Very truly yours,

B. W. BURNET.

GILLETTE, Morris County, N. J., Oct. 20th, 1898.

Mr. Henry I. Budd, State Commissioner of Public Roads, Trenton, N. J.:

DEAR SIR—Road improvement in our county has received a great deal of attention for a few years past, and the interest of the community in good roads has constantly increased until hardly an exception can be found, all being ardent advocates of good roads.

The fact the roads can be made in country places so that at any time of year crops can be moved and loads transported to market with ease and rapidity, and pleasure driving continued in winter as in summer, adds very greatly to the pleasure and profit of our people, when the roads are so made. We feel that the State should lend a helping hand in the accomplishment of this work to a greater extent than it has hitherto done. It seems to us that this proprietor, the State, can and should extend this aid that benefits the whole of her people.

Hoping that we may obtain an increased appropriation for this object, I remain,

Yours very sincerely,

R. N. CORNISH.

RUTHERFORD, N. J., Oct. 10th, 1898.

Mr. Henry I. Budd, State Commissioner of Public Roads, Trenton, N. J.:

DEAR SIR—I have talked with a number of the more progressive men in this county (Bergen), and they all, without exception, favor increasing the annual appropriation for State aid in road-building as largely as possible. They also favor the extension of State aid to all roads that may be called main thoroughfares in boroughs, villages, &c. Many smaller municipalities find it difficult to secure the money necessary to improve even their main avenues of travel.

Last fall and this summer we have built at Lodi, N. J., under the writer's supervision as engineer, a little over three miles of macadam road, part four inches thick and part six inches. The road was built differently than any in this section, and, we think, is an improvement over the existing roads. The subgrade was first rolled with a heavy steam roller until very compact, all soft places being dug out and

refilled with suitable material. For four-inch roads, one-and one half-inch trap-rock was spread on to such thickness that it made a layer four inches thick after rolling. This layer was then rolled with a heavy twelve-and-one-half ton steam roller, until the roller made no impression on it and the stones would not move when walked upon. Fine limestone was then spread over the stone and well watered and rolled until all the interstices were filled and the water flushed and made mud on the surface. In this way we secured a very smooth, hard road, and one which is free from dust after the first winter. About 3,500 feet built this way last fall showed no ravel this summer, even though it was not sprinkled, and carried an average traffic of about 150 wagons per day.

We have had from three to four loads per day of seven and one-quarter tons per load on narrow tires go over these roads for about two weeks without their showing even a wheel mark, while the adjoining macadam has been badly rutted.

Inclosed find photo of road we built last fall, which was taken this summer.

We think that it would be well if the Legislature would pass some laws governing the load to be carried per inch of tire on macadamized roads, or give localities having improved roads the right to pass ordinances governing the weight in relation to tire that could be carried over their roads, whether by local wagons or those coming from other parts. Something in this line is very badly needed.

Very truly yours,

W. C. FOSTER,
Engineer, Borough of Lodi.

WOODBURY, N. J., Oct. 10th, 1898.

Mr. Henry I. Budd, State Commissioner of Public Roads, Trenton, N. J.:

DEAR SIR—The roads now built in our county seem to be giving so much satisfaction that there are applications before the Board of Freeholders for extensions in both a southerly and an easterly direction reaching to the county line.

At first there was a strong feeling against them, and a great deal of work was required to get the requisite number of signers for the first road; but the feeling against them has died out, and the people are willing to pay the taxes necessary to build and maintain good roads; this is proven by the large number of applications for such roads now before the Board of Freeholders.

Articles have appeared in the Philadelphia papers asserting that the improved roads of New Jersey were being neglected—notably the one from Westville to Paulsboro. After a drive over the improved roads of Gloucester county, including the Westville and Paulsboro road, I can assure you they are in good condition. In some few places there are small ruts, but not large enough to retain the stone necessary to repair with.

Very truly yours,

JOHN G. WHITALL.

MORRISTOWN, N. J., Oct. 26th, 1898.

Mr. Henry I. Budd, State Commissioner of Public Roads, Trenton, N J.:

DEAR SIR—While we did not build as many miles of road in Morris county this year as last, the roads we did build were very important, as they were connecting links; that is, connected one macadam road with another. As a rule our roads wear very well.

Main St., Lodi, N. J., Bergen Co. Before.

A very bad piece of road, extremely hard on horses before improvement.

Main St., Lodi, N. J., Bergen Co. After.

Four-inch Macadam with Limestone binder and finish, extremely hard and does not ravel.
W. C. Foster, Engineer.

A great many property-owners in this section were opposed to stone roads before any were constructed. They said dirt roads had always been good enough and were still. Now that they see the advantages of good roads, they have changed their opinions and would like to have stone roads all over. I think the more stone roads we build the more the people will see the advantages to be derived from them and the more stone roads they will demand.

Applications for roads are constantly coming in to the Board of Chosen Freeholders of Morris county under the State Aid act. We have applications enough now to use up all of next year's appropriation if we could get it.

Truly yours,
G. A. Becker.

Gloucester City, N. J., October 7th, 1898.

Mr. Henry I Budd, State Commissioner of Public Roads, Trenton, N. J.:

Dear Sir—The number of teams carried by the Gloucester ferry from the 1st day of January until the 31st day of October, 1894 (this being before the stone roads were built), was 93,350, both ways. From January 1st until October 31st, 1898, when the stone roads were in full operation, we carried 121,606 teams both ways, this being an increase of about 27 per cent. in 1898. Now, the Glassboro and Paulsboro roads are about finished and we find that our travel is still more increasing.

In reference to the number of baskets carried I can safely say that where the farmers, in 1894, carried about fifty to sixty baskets to a load, they now carry from one hundred to one hundred and seventy-five baskets. The farmers at the present time carry 400 per cent. more fertilizer over this ferry than they ever did before. Before the stone roads were built the farmers could not take over one load of fertilizer at a time, and then usually had three or four horses to a team; but at the present time, and since the building of the stone roads, we never have a farmer's team with more than two horses, and they are able to take four tons instead of one ton the entire distance to the farm.

Very truly yours,
Wm. J. Thompson,
Treasurer.

WIDE TIRES IN 1767.

Trenton, N. J., Nov. 28th, 1898.

Mr. Henry I. Budd, State Commissioner of Public Roads, Trenton, N. J.:

Dear Sir—Although the wide-tire agitation has usually been considered a matter of recent history, it is not generally known that New Jersey, when yet a province of the English crown, had upon her statute-books a wide-tire law. One hundred and thirty-one years ago, in June, "An act to regulate carriages of burden within this colony" was passed. Thus read the preamble to this law of 1767:

"Whereas the difference in the track or running of waggons and wheel carriages of burden in the several counties of this colony is found by experience to be very inconvenient, and the narrowness of the fellies pressing or running on the ground to be prejudicial and destructive to the roads," it was enacted that all "waggons or carriages of burden to be drawn by four or more horses, oxen or other cattle" made after May 1st, 1768, traveling on the colony roads, and belonging to Jerseymen, "shall run or track on the ground, from center to center of the fellies, no less than five feet English measure under the penalty of twenty shillings" Regarding the

broad tire it was further provided that all such wagons and carriages made after May 1st, 1770, "shall have the fellies or part of the wheels which press upon the ground at least four inches broad on the surface" under like penalty.

The statute was limited to vehicles of the class above specified and was not to be taken or construed "to affect light waggons which are used on farms or for the use of going to mill and market or places of divine worship."

It is of interest to know that this act remained in force during the entire Revolutionary period, and its passage undoubtedly gives to New Jersey the honor of being, in all probability, the first State to advocate a wide-tire law.

FRANCIS B. LEE.

OFFICE OF MASSACHUSETTS HIGHWAY COMMISSION,
MOUNT VERNON STREET, Boston, December, 1898.

REPORT ON VISIT TO SOME OF THE NEW JERSEY ROADS.

During the week ending April 23d, 1898, a view was taken of certain roads built in New Jersey under the State Aid act. Through the courtesy of the State Road Commissioner, Hon. Henry I. Budd, every opportunity was given us to see the different types of road which have been built, and to study the methods used in their building.

The roads visited were built either of trap-rock or gravel, and were in excellent condition. Telfording was used over a clay subsoil, and side drains were built where ground-water stood near the surface.

The width of the roadway varies from 9 to 16 feet, by far the larger number being 12 feet or 10 feet wide.

The depth of the broken stone varies from 4 to 12 inches. On most of the roads it is 8 inches. Telford roads are built with 8 or 12 inches of stone, most of them being 8 inches.

In the telford roads, 5 inches is of hand-laid ledge stone, and a covering of 3 inches of broken stone. No gravel is placed under the telfording. The telfording is not rolled with a heavy roller before the broken stone is placed. Clay is often used on the telfording and also on the broken stone. Some of the roads are built by using a steam-roller and some a horse-roller.

The side drains are built without any stone or gravel, the back-filling being made with the material excavated from the pipe trench.

Most of the roads examined traversed a fairly-level country, requiring but little excavation to give an easy grade, and the cost of grading on the average road is very small. A greater part of what little grading has been done is in material that can be moved cheaply, as it shovels easily, without picking, and is hauled short distances only. In the few cases where much grading was done, the cost averaged about the same as on Massachusetts roads.

All work is done by contract after advertisement. The contract requires payment on a basis of square-yard measurement of roadway built, and this price covers the cost of shaping and finishing, and in general, all other work required of the contractor excepting grading. The grading is done at a stipulated price per cubic yard.

Information as to the actual cost to the contractor, and of the quantities of materials used, are hard to get, on account of the system of contracting. The State does not have it, and the contractor will not, or cannot, furnish it. However, it was ascer-

tained that labor is paid $1.25, and double teams, with cart and driver, $3 per day of ten hours. Trap-rock is delivered by rail at a maximum cost of $1.15 per ton on the cars at its point of destination.

The cost of hauling rock over the roads already improved is fairly low. The steam railroad system is such that the average haul over the highway is short. These different items of cost being low makes it possible to place the stone on the roads at an average price considerably below $2 per ton, possibly not more than $1.60.

As has already been stated, most of the roads nominally have a depth of stone equal to eight inches. It was stated that nine inches of broken stone rolls to eight inches, A mile of road, fifteen feet wide, on this basis, requires about 2,933 tons of broken stone, estimating a cubic yard to weigh one and one-third tons. At $1.60 per ton, the cost of the 2,933 tons of stone is $4,693, The one contractor met with, and at work, gave the amount of broken stone used on a given length and width, which showed that that particular road used stone at the rate of 3,000 tons per mile of road fifteen feet wide. These figures practically agree with the ones obtained in the Massachusetts work on a road six inches thick after rolling.

In the New Jersey work the stone is spread to a depth of nine inches, which is assumed to give a depth of eight inches after rolling, while in the Massachusetts work the stone is laid onto arbitrary grades, and an absolute depth of six inches is maintained.

In the New Jersey work the contract is for a stipulated price per square yard, while in the Massachusetts work all the broken stone is weighed, and the contractor is paid for each ton placed on the road.

By referring to the above method of spreading stone on the New Jersey roads, it seems a simple matter to estimate the number of tons of stone required on any road, and this is about 3,000. On the other hand, by maintaining the top surface of the stone to an arbitrary grade, much loss is met with by stone being pressed downward into the subgrade, and the average number of tons of stone per mile of fifteen-foot road is considerably increased.

The price of labor in Massachusetts is $1.50 a day of nine hours, and of a double team and driver $3.50 per day of nine hours. By comparing the price of labor and team hire and length of day, it will be noted that the prices paid in Massachusetts are higher than in New Jersey by 20 per cent. on labor, 16⅔ per cent. on teams, and about 11 per cent. on the length of the day.

The figures already given indicate that in New Jersy a mile of broken-stone road, fifteen feet wide, costs about $4,700. A study of the Massachusetts State roads indicates that a mile of broken-stone road, fifteen feet wide, costs about $5,700. With a nine-hour day, the cost of the New Jersey work would be increased 11 per cent., and be $5,217 per mile. A still further increase would be made on account of the price of labor and teams. The hours of labor in Massachusetts are fixed by legislative act. The price per day for labor and teams is fixed by custom, and it would seem that the increased cost of Massachusetts roads, due to these two causes, cannot well be prevented.

In the matter of the greater number of tons of broken stone per mile of Massachusetts road as compared with the New Jersey road, it may be said that the number of tons of stone per mile of Massachusetts road has been gradually reduced, until the average for the last year's roads is not much greater than it is in New Jersey.

One point of interest in connection with the New Jersey roads is that all the bridges, culverts and fences are built by the county. In some of the counties the

rough grading is done by the county, so that the road built by the State does not include much more than the broken-stone surfacing. More or less work has also been done by private subscription.

Thus far in this report comparison has been made between roads one mile long and fifteen feet wide. Reference has already been made to the fact that the roads in New Jersey are generally ten or twelve feet wide. Wherever these narrow roads have been built they have given general satisfaction, and there is no reason to suppose that they would not be equally satisfactory in Massachusetts on all except heavily. traveled roads. The saving in cost, by narrowing from a fifteen-foot roadway, would be about $1,140 per mile if reduced to twelve feet, and $1,900 if reduced to ten feet.

Many miles of excellent gravel roads have been built in New Jersey at a cost of $1,000 to $1,300 per mile. Much of the gravel thus used was found near the road; some of it was taken from hills on the road; none of it required special treatment, and the average haul was short.

The so-called gravel, which gave the best results, was made up of grit or pebbles 50 per cent., sand 30 per cent., and clay 20 per cent. This was placed on the road to a depth of 8 inches, in two courses, and thoroughly harrowed and rolled. These gravel roads are reported to wear well, and cost but little for maintenance.

Except within limited areas natural gravel such as has been described cannot be found in Massachusetts; but there are many localities where the same results can be economically obtained, by a mixture of stone, sand and clay.

It is interesting to note that the use of the clay binder on the New Jersey roads does not prevent the raveling out of the surface stone.

While we saw nothing to criticise, we saw much to commend in your methods of building, in the width of the roadway and the location of the roads built. We obtained many suggestions while looking over your work that will be a help to us in Massachusetts. Pleased with the result of your narrow roads, we are giving ours less width, and believe in gravel roads under certain conditions; namely, where the traffic is light and gravel can be had at a reasonable cost.

On the whole, New Jersey may well be proud of her State roads.

W. E. McCLINTOCK,
Massachusetts Highway Commissioner.

APPENDICES.

APPENDIX A.

AMENDED FORM OF SPECIFICATIONS USED FOR STONE ROAD (MACADAM) CONSTRUCTION UNDER THE STATE AID LAW.

Specifications for a macadam stone road in ——— county, New Jersey, known as ——— road, beginning at ——— in the ——— of ———, extending to ———, a distance of ——— miles.

WORK TO BE PERFORMED.

1. The work to be performed will consist in furnishing all material, tools, machinery and labor necessary and proper for the efficient and proper grading of roadway, side ditches and side banks; laying, spreading and rolling of road metal, and leaving the roadway complete in every manner ready for immediate use.

PLANS, DRAWINGS.

2. The plans and cross-sections on file at the office of ———, County Engineer, ———, N. J., show general location, profile, details and dimensions, and the work will be constructed in all respects according to the above-mentioned plans and cross-sections which form part of these specifications.

3. Any variation of location, profile, size and dimension from that shown on the plans as may be required by the exigencies of construction will in all cases be determined by the Engineer; but the contractor shall not on any pretense, save that of the written order of the contracting parties, including the State Commissioner of Public Roads, deviate from the intent of the plans or specifications.

4. On all drawings, figured dimensions are to govern in cases of discrepancy between scale and figure.

GRADING.

5. Under this head will be included all excavation and embankment required for the formation of the highway; cutting all ditches or drains about or contiguous to the road; removing all fences, walls, buildings, trees and poles; the excavation and embankment necessary for reconstructing cross or branch roads in cases where they are destroyed or interfered with in the formation of the roadway, and all other excavations and embankments connected with or incidental to the construction of the said road.

EXCAVATION.

6. The roadway to the widths as shown on plans to be excavated or built to a curvature to conform to the final surface of the road when finished; the grade from center to sides being as shown on plans.

7. The earth taken from any cut or ditch shall be deposited where Engineer may direct, either within or without the lines of the road, but no earth shall be removed from the line of the road without the order of the Engineer.

EMBANKMENT.

8. Material taken from the excavation, except when otherwise directed by the Engineer, shall be deposited in the embankment; the cost of removing such shall be included in the price paid for excavation. The price paid for excavation will be understood to cover and pay for the entire expense of its removal by any method whatver, including loading, transportation and deposit, in the manner prescribed in these specifications, in the places designated by the Engineer.

9. All material necessarily procured from without the road and deposited in the embankment will be paid for as excavation only.

10. The embankments will be formed in layers of such depth (generally six (6) inches), and the material deposited and distributed in such a manner as the Engineer may direct, the required allowance for settling being added.

SLOPES.

11. Slopes in both embankment and excavation shall be one and one-half ($1\frac{1}{2}$) horizontal to one (1) vertical, according to slope stakes, unless otherwise ordered.

CONSTRUCTION.

12. The construction to be macadam, ——— inches and ——— inches in depth when completed, and ——— feet and ——— feet wide respectively, as shown on plans.

ROADWAY.

Sub-Foundations.

13. When the excavations and embankments have been brought to a proper depth below the intended surface of the roadway, and the cross-section thereof, conforming in every respect to the cross-section of the road when finished, the same shall be rolled with a ten (10) ton steam-roller until approved by the Engineer. If any depressions form under such rolling, owing to improper material or vegetable matter, the same shall be removed and good earth substituted, and the whole re-rolled until thoroughly solid and to the above-mentioned grade.

14. After the roadbed has been prepared and properly rolled, it shall not be disturbed by any carting or hauling upon the surface.

MACADAM.

First Course of Broken Stone.

15. After the roadbed has been formed and rolled, as above specified, and has passed the inspection of the Engineer and Supervisor, the first layer of broken stone, consisting of one-and-one-half ($1\frac{1}{2}$) inch stone, or stone that will pass through a ring two (2) inches in diameter, shall be deposited in a uniform layer, having a depth of ——— inches and ——— inches, respectively, for the ——— inch and ——— inch macadam and rolled repeatedly with a ten (10) ton steam-roller until compacted to the satisfaction of the Engineer and Supervisor.

BINDER BETWEEN FIRST AND SECOND COURSE.

16. On the first course of stone a quantity of stone-screenings shall be spread in a uniform layer and the rolling continued until the stone cease to sink or creep in front of the roller; water will be applied in advance of the roller, but not in excess. The quantity and quality of this and all other binding to be at all times subject to the approval of the Engineer.

SECOND COURSE OF BROKEN STONE.

17. The second course of broken stone shall consist of one-and-one-quarter ($1\frac{1}{4}$) inch stone, that is, every piece of stone shall be broken so it can be passed through a ring one and one-half ($1\frac{1}{2}$) inches in diameter, and no stone shall be more than two (2) inches or less than one (1) inch long. This course is to be spread in a uniform layer of sufficient thicknes to make the macadam at least ——— inches and ——— inches in depth respectively, when completed, including $\frac{3}{4}$-inch stone and screenings for the surface, and rolled until thoroughly settled into place to the satisfaction of the Engineer and Supervisor.

SURFACE.

18. When the two courses are rolled to the satisfaction of the Engineer and Supervisor, a coat of three-quarter ($\frac{3}{4}$) inch stone and screenings is to be spread of sufficient thickness to make a smooth and uniform surface to the road, then again thoroughly rolled until the road becomes thoroughly consolidated, hard and smooth, and a small stone placed on the surface will be broken before being driven into the bed.

19. Rolling to be done by contractor with a ten (10) ton steam-roller, approved by the Engineer.

20. Any depressions formed during the rolling, or from any other cause, are to be filled with three-quarter ($\frac{3}{4}$) inch stone and screenings, and the roadway brought to a proper grade and curvature as determined by the Engineer.

21. Water must be applied in such quantities and in such manner as to completely fill all the voids between the broken stone, with the binding material saturated so as to secure a set.

MANNER OF ROLLING.

22. In the rolling the roller must start from the side lines of the stone bed and work towards the center, unless otherwise directed. The rolling shall at all times be subject to the directions of the Engineer and Supervisor, who may, from time to time, direct such methods of procedure as in their opinion the necessities of the case may require.

QUALITY OF MATERIAL.

23. All stone must be as nearly cubical as possible, broken with the most approved modern stone-crushing machinery, free from all screenings, earth and other objectionable substances, of uniform size and the same kind and quality, or equally as good in every particular as that shown in the Engineer's office. The one-and-one-quarter ($1\frac{1}{4}$) inch stone, three-quarter ($\frac{3}{4}$) inch and screenings for binder and final finish must be of the best trap-rock, free from loam or clay.

24. The contractor must furnish samples of the kind of stone to be used in the work to the Engineer before the opening of the bids.

SHOULDERING.

25. A shoulder of firm earth or gravel is to be left or made on each side, extending at the same grade and curvature of road to side ditches or gutters. This shoulder is to be thoroughly rolled for its entire width on each side of the stone bed; this shoulder to never be of less width than seven (7) feet from the stone bed, where the width of the road will admit.

26. When necessary the side ditches or gutters are to be excavated as per stakes furnished by Engineer, to give an easy flow of water, so that no water shall be left standing on the road or in the ditches, for all of which no extra payment will be made.

UNDERDRAINS.

27. Underdrains, if found necessary, shall be constructed by the contractor (at prices named in bids) of good four (4) inch sole tile, laid upon a board of not less than one (1) inch in thickness and six (6)

inches in width, whenever and wherever the Engineer shall decide; top of tile to be at least thirty (30) inches deep, unless otherwise directed by the Engineer, the joints of the tile to be covered with salt hay or material equally as good, and trench filled with pervious earth; or a drain (trench) constructed of stone.

NO EXTRA PRICE.

28. No allowance in measure of depth of pavement will be made on account of any material which may be driven into the roadbed by rolling. The pavement, when completed, must conform to the grade and cross-section, and be satisfactory to the Engineer, whose decision shall be final.

29. No extra work will be paid for unless the price has been agreed between the contracting parties, including the State Commissioner of Public Roads, and indorsed upon the agreement, witnessed by the Engineer.

30. When extra depth of pavement is required, it must be obtained by making the pavement thinner on the more solid portions of the road. Changes in depth to be made only upon the written order of Engineer and State Commissioner of Public Roads, and as located by them.

31. All clay or gravel for shouldering and all extra hauling to be at the contractor's expense.

BIDS.

32. Bids will only be received under these specifications for the road complete. The prices per yard for excavating and macadam are intended for the use of the Engineer in making monthly estimate of work done to the Board of Freeholders. No bids will be received in which all of the following items are not filled out:

(1) Price per cubic yard for earth and shale excavations, without classification, as per cross-sections throughout the length and width of the road.

(2) Price per cubic yard for rock excavations, without classification, as per cross-sections throughout the length and width of the road.

(3) Price per square yard for four (4) inch macadam road complete.

(4) Price per square yard for six (6) inch macadam road complete.

(5) Price per square yard for eight (8) inch macadam road complete.

(6) Price per lineal foot, for underdrains, furnishing all labor and material.

(7) Price (lump) for the whole road complete, according to above specifications and plans prepared by the Engineer.

ESTIMATE OF QUANTITIES.

33. (1) Excavations, ——— cubic yards.
(2) Four (4) inch macadam, ——— square yards.
(3) Six (6) inch macadam, ——— square yards.
(4) Eight (8) inch macadam, ——— square yards.
(5) Underdrains, ——— lineal feet.

34. These quantities are the result of careful calculation, but are to be considered as approximate. The county will not be responsible for any excess in above quantities, should any occur. The contractor is expected to satisfy himself as to the nature, character and quantity of the labor and material required by a personal examination of the work contemplated.

35. Bids shall be accompanied by approved bond, to insure the execution of the agreement, to the amount of at least one thousand ($1,000) dollars.

LIABILITIES OF CONTRACTOR.

36. He shall keep up sufficient guards by day and night to prevent accidents from travel, and will be liable for any damage which may arise by his neglect to do so, or from any omission on his part.

37. He shall keep the road sprinkled until the final certificate of completion by the Engineer is given.

38. He is to commence and prosecute the work upon the road at such points as may be directed by the Engineer and Supervisor, within ——— days from and after the signing of the contract, and shall continue work thereon until completion, except as herein provided.

39. He further agrees to complete the same on or before the ——— day of ——— , A. D. ———. Twenty dollars for each day that the work shall remain uncompleted after the time allowed by contract may be deducted from any moneys due contractor, as liquidated damages. A bonus or premium of $1 per month will be paid the con-

tractor for each month the road is completed before the time specified in the contract, except only to the provisions herein contained, unless otherwise agreed upon by the Board of Freeholders, on certificate of the Engineer recommending the extension of the time-limit of completion.

40. The contractor shall keep the finished roadway and earthwork in repair for the space of one year from the date of its completion and acceptance, and shall be liable for wear and tear caused by ordinary travel, and as much longer as for any period or periods during said year it shall be out of proper condition; and if during that time the roadway or any part of the work shall, in the judgment of the Engineer and Board of Freeholders, require repairing, and they shall duly notify the contractor to make repairs as required, and if the contractor shall refuse or neglect to do so, to the satisfaction of the said Engineer and Board of Freeholders, within five days from the date of service of notice, then said Engineer and Board of Freeholders shall have the right to have the work done properly by other parties and pay the expense for the same out of the five per cent. retained.

41. The contractor will be required to preserve all stakes and bench-marks made and established on the line of the work, until duly authorized by the Engineer to remove the same.

42. The contractor shall not disturb the position of title-stones (the corners to properties adjacent to road); where they appear he will either lift or lower them so that their tops may conform with the finished surface of the stone construction under the personal supervision of the Engineer.

43. The contractor must also preserve the roadway on which he is working from needless obstruction, and where necessary will construct safe and commodious crossings, to be maintained in good order, and to afford all proper and reasonable means for the accommodation of the public.

ENGINEER.

44. The Engineer is to be selected or appointed by the Freeholders and paid by them. He is to furnish all surveys, profiles, plans, specifications and quantities of all kinds before specifications are signed, and in such a clear manner that lump bids can be made upon the work. He is to place stakes at small intervals on opposite sides of the road, marked for the finished grade, so that by line and rule the

depth of pavement can be easily and correctly determined. He is also to furnish estimates of quantities of work done before partial payments are made, the quantity of road laid to be determined by surface measurement, and should any difference arise between the contracting parties as to their meanings, his decisions on these matters are to be final and conclusive. The work is to be done according to his direction, and if any material is brought upon the road not approved by him, it is to be removed at the expense of the contractor.

RIGHT TO BUILD BRIDGES, CULVERTS, ETC., AND SUSPENSION OF WORK.

45. The right of the county to build bridges, culverts, or lay pipes or other appurtenances in connection therewith, in said road, during the progress of the work, is expressly reserved, as well as suspending the work, or any part thereof, during the construction of the same for the purpose above stated, without further compensation to the contractor for such suspension than an extension of time for completing the work as much as it may have been delayed by such suspension.

STOPPING WORK ON ACCOUNT OF WEATHER.

46. The Supervisor, in his discretion, may stop any portion of the work if, in his judgment, the weather is such as to prevent the same being done properly. No allowance of any kind will be made for such stoppage, except an extension of the time for the completion of the work as herein provided for.

ABANDONMENT OF CONTRACT.

47. If at any time the work under contract should be abandoned, or if at any time the Supervisor or Engineer should judge and so certify in writing that said work or any part thereof is unnecessarily delayed, or that the contractor is wilfully violating any of the conditions or covenants of this contract, or is executing the same in bad faith, the Board shall thereupon notify the said contractor to discontinue all work under this contract, and may employ other parties to complete the work in such manner as they may decide, and use such

material as they may find upon the line of said work, and to procure other material for its completion, and charge the expense of the said labor and material to the contractor, to be deducted from any moneys due him under contract, and in case such expenses shall exceed the sum which would have been payable under contract, if the same had been completed by said contractor, he or his bondsmen shall pay the amount of the excess to the Board of Freeholders, on notice from the Engineer.

SUPERVISOR.

48. Nothing in these specifications, relating to the duties of the Engineer, shall be taken or construed to, in any manner, conflict with the duties of the Supervisor in the performance of his duties, as specifically set forth in the act entitled "An act to provide for the more permanent improvement of the public roads of this State," approved March 22d, 1895, and the supplements thereto, but they shall co-operate as far as practicable. The contractor shall employ competent men to do the work, and, whenever the Supervisor shall inform him in writing that any man on the work is unfitted for the place, or is working contrary to the provisions of the specifications or the instructions of the Engineer, he shall thereupon be discharged.

INSPECTION.

49. All directions and determinations, necessary to give due and full effect to any of the provisions of these specifications, shall be given by the Engineer and Supervisor.

50. All material and workmanship of any kind shall be subject at all times to the inspection of the Engineer and Supervisor. Whenever unfaithful and imperfect work is discovered it shall be repaired or replaced by the contractor, after due notification from the Engineer and Supervisor.

SUBLETTING OF CONTRACT.

51. The contractor shall not assign or sublet any portion of this contract without the consent of the Board of Freeholders and the State Commissioner of Public Roads.

PAYMENTS.

52. Monthly payments will be made by the Board of Freeholders to the contractor, if desired, for all completed work, upon presentation by him of the proper certificates of the Engineer and Supervisor to the extent of eighty per cent. of the amount then due. Fifteen per cent. will be paid at the completion of the work. The balance (five per cent.) will be retained by the said Board of Freeholders to keep the roadway completed by the contractor in good repair in case said contractor fails to do so during the period of one year, after the expiration of which time and the final release of the contractor the said balance of five per cent., or such portion of it as has not been expended as aforesaid, will be paid over to the contractor.

BOND OF CONTRACTOR.

53. The contractor will be required to execute, within five days after giving of contract, a bond in such sum and with such securities, and not less than fifty per cent. of the cost of the road when completed, as shall be approved by the Board of Freeholders or its committee, conditioned for the faithful performance of the contract, and to indemnify and save harmless the parties of the said Board of Freeholders or its committee from all suits or actions of any name or description brought against them for or on account of any injuries or damages received or sustained by any party or parties, by or from the said contractor, his servants or agents, in the construction of said work, or by or in consequence of any negligence in guarding the same, or any improper material used in its construction, or by or on account of any act or omission of the contractor or his agents, and for the faithful performance of the contract by the contractor, and the said contractor hereby further agrees that so much of the money due him under and by virtue of this agreement, as shall be considered necessary by the Board of Freeholders or its committee, may be retained by the said Board of Freeholders or its committee until all such suits or claims for damages aforesaid shall have been settled, and evidence to that effect furnished to the satisfaction of the said Board of Freeholders or its committee.

CONTRACTOR TO INSURE PAYMENT FOR LABOR, MATERIAL, ETC., ON FINAL ESTIMATE.

54. The contractor must also furnish said Engineer and Supervisor with satisfactory evidence that all persons who did work or furnished material for this contract, or who have sustained damage or injury by reason of any act, omission or carelessness on his part or his agents, in the prosecution of the work, have been fully paid and secured; and shall also give notice to said Engineer and Supervisor within ten (10) days after the completion of the work, that any balance for such work or materials, or compensation for such damage still due, has been fully paid or released.

PERSONAL ATTENTION.

55. The contractor must give his personal attention to the work and not assign or sublet the same, but keep the same under his control.

_____ _____,
County Engineer.

_____ _____,
_____ _____,
_____ _____,
_____ _____,
_____ _____,
Road Committee.

Approved this _____, A. D. _____, by resolution of the Board of Chosen Freeholders.

_____ _____,
Director Board of Chosen Freeholders.

_____ _____,
Clerk of Board of Chosen Freeholders.

OFFICE STATE COMMISSIONER OF PUBLIC ROADS,
TRENTON, N. J.

I have this day carefully read and examined the foregoing specifications, and the same are hereby approved.

Any departure from these specifications which increases the cost of

the road must have the written consent of the State Commissioner of Public Roads.

Given under my hand this ———, A. D. ———.

———— ————,
State Commissioner of Public Roads.

AMENDED FORM OF SPECIFICATIONS USED FOR TELFORD ROAD UNDER THE STATE AID LAW.

Specifications for a telford macadam stone road in ——— county, New Jersey, known as ——— road, beginning at ———, in the ———, extending to ———, a distance of ——— miles.

WORK TO BE PERFORMED.

1. The work to be performed will consist in furnishing all material, tools, machinery and labor necessary and proper for the efficient and proper grading of roadway, side ditches and side banks; laying, spreading and rolling of road metal, and leaving the roadway complete in every manner ready for immediate use.

PLANS, DRAWINGS.

2. The plans and cross-sections on file at the office of ———, County Engineer, ———, N. J., show general location, profile, details, and dimensions, and the work will be constructed in all respects according to the above-mentioned plans and cross-sections which form part of these specifications.

3. Any variation of location, profile, size and dimension from that shown on the plans as may be required by the exigencies of construction will in all cases be determined by the Engineer; but the contractor shall not on any pretense, save that of the written order of the contracting parties, including the State Commissioner of Public Roads, deviate from the intent of the plans or specifications.

4. On all drawings, figured dimensions are to govern in cases of discrepancy between scale and figure.

GRADING.

5. Under this head will be included all excavation and embankment required for the formation of the highway; cutting all ditches or drains about or contiguous to the road; removing all fences, walls, buildings, trees and poles; the excavation and embankment necessary for reconstructing cross or branch roads in cases where they are destroyed or interfered with in the formation of the roadway, and all other excavations and embankments connected with or incidental to the construction of the said road.

EXCAVATION.

6. The roadway to the width as shown on plans to be excavated or built to a curvature to conform to the final surface of the road when finished; the grade from center to sides being as shown on plans.

7. The earth taken from any cut or ditch shall be deposited where Engineer may direct, either within or without the lines of the road, but no earth shall be removed from the line of the road without the order of the Engineer.

EMBANKMENT.

8. Material taken from the excavation, except when otherwise directed by the Engineer, shall be deposited in the embankment; the cost of removing such shall be included in the price paid for excavation. The price paid for excavation will be understood to cover and pay for the entire expense of its removal by any method whatever, including loading, transportation and deposit, in the manner prescribed in these specifications, in the places designated by the Engineer.

9. All material necessarily procured from without the road and deposited in the embankment will be paid for as excavation only.

10. The embankments will be formed in layers of such depth (generally six (6) inches), and the material deposited and distributed in such a manner as the Engineer may direct, the required allowance for settling being added.

SLOPES.

11. Slopes in both embankment and excavation shall be one and one-half ($1\frac{1}{2}$) horizontal to one (1) vertical, according to slope stakes, unless otherwise ordered.

CONSTRUCTION.

12. The construction to be telford bottom, ——— inches and macadam surface, ——— inches; total depth when completed, ——— inches and ——— feet and ——— feet wide respectively, as shown on plans.

ROADWAY.

Sub-Foundations.

13. When the excavations and embankments have been brought to a proper depth below the intended surface of the roadway, and the cross-section thereof, conforming in every respect to the cross-section of the road when finished, the same shall be rolled with ——— roller until approved by the Engineer. If any depressions form under such rolling, owing to improper material or vegetable matter, the same shall be removed and good earth substituted, and the whole re-rolled until thoroughly solid and to above-mentioned grade.

14. After the roadbed has been prepared and properly rolled, it shall not be disturbed by any carting or hauling upon the surface.

TELFORD FOUNDATIONS.

15. After the roadbed has been formed and rolled, as above specified, and has passed the inspection of the Engineer and Supervisor, a bottom course of stone, of average depth of ——— inches, to be set by hand as a close, firm pavement, the stones to be placed on their broadest edges lengthwise across the road and so as to break joints as much as possible, the breadth of the upper edge not to exceed four (4) inches. The interstices are then to be filled with stone chips, firmly wedged by hand with hammer and projecting points broken off. No stone to be used of a greater length than ten (10) inches or width of four (4) inches, except each alternate stone on outer edge, which shall

be double the length of the others and well tied into the bed of the road; all stone with a flat, smooth surface to be broken. The whole surface of this pavement to be subjected to a thorough settling or ramming with heavy sledge-hammers and thoroughly rolled with a five or seven-ton roller. No stones larger than one and one-half inches to be left loose on top of telford.

BINDER BETWEEN FIRST AND SECOND COURSE.

16. On the telford course of stone a quantity of ——— binder shall be spread in a uniform layer and the rolling continued until the stone cease to sink or creep in front of the roller; water will be applied in advance of the roller, but not in excess. The quantity and quality of this and all other binding to be at all times subject to the approval of the Engineer.

SECOND COURSE OF BROKEN STONE.

17. The second course of broken stone shall consist of one-and-one-quarter ($1\frac{1}{4}$) inch stone; that is, every piece of stone shall be broken so it can be passed through a ring one and one-half ($1\frac{1}{2}$) inches in diameter, and no stone shall be more than two (2) inches or less than one (1) inch long. This course is to be spread in a uniform layer of sufficient thickness to make the macadam at least ——— inches and ——— inches in depth respectively, when completed, including the $\frac{3}{4}$-inch stone and screenings for the surface, and rolled until thoroughly settled into place to the satisfaction of the Engineer and Supervisor.

SURFACE.

18. When the two courses are rolled to the satisfaction of the Engineer and Supervisor, a coat of three-quarter ($\frac{3}{4}$) inch stone and screenings is to be spread of sufficient thickness to make a smooth and uniform surface to the road, then again thoroughly rolled until the road becomes thoroughly consolidated, hard and smooth, and a small stone placed on the surface will be broken before being driven into the bed.

19. Rolling to be done by contractor with a ten (10) ton steam-roller, approved by the Engineer.

20. Any depressions formed during the rolling, or from any other cause, are to be filled with three-quarter ($\frac{3}{4}$) inch stone and screenings, and the roadway brought to a proper grade and curvature as determined by the Engineer.

21. Water must be applied in such quantities and in such manner as to completely fill all the voids between the broken stone, with the binding material saturated so as to secure a set.

MANNER OF ROLLING.

22. In the rolling the roller must start from the side-lines of the stone bed and work toward the center, unless otherwise directed. The rolling shall at all times be subject to the directions of the Engineer and Supervisor, who may, from time to time, direct such methods of procedure as in their opinion the necessities of the case may require.

QUALITY OF MATERIAL.

23. All stone must be as nearly cubical as possible, broken with the most approved modern stone-crushing machinery, free from all screenings, earth and other objectionable substances, of uniform size and the same kind and quality, or equally as good in every particular as that shown in the Engineer's office. The one-and-one-quarter ($1\frac{1}{4}$) inch stone, three-quarter ($\frac{3}{4}$) inch and screenings for binder and final finish must be of the best trap-rock, free from loam or clay.

24. The contractor must furnish samples of the kind of stone to be used in the work to the Engineer before the opening of the bids.

SHOULDERING.

25. A shoulder of firm earth or gravel is to be left or made on each side, extending at the same grade and curvature of road to side ditches or gutters. This shoulder is to be thoroughly rolled for its entire width on each side of the stone bed. This shoulder to never be of a less width than seven (7) feet from the stone bed, when the width of the road will admit.

26. When necessary the side ditches or gutters are to be excavated as per stakes furnished by Engineer, to give an easy flow of water, so that no water shall be left standing on the road or in the ditches, for all of which no extra payment will be made.

UNDER-DRAINS.

27. Under-drains, if found necessary, shall be constructed by the contractor (at prices named in bids) of good four (4) inch sole tile, laid upon a board of not less than one (1) inch in thickness and six (6) inches in width, whenever and wherever the Engineer shall decide; top of tile to be at least thirty (30) inches deep, unless otherwise directed by the Engineer, the joints of the tile to be covered with salt hay or material equally as good and trench filled with pervious earth.

NO EXTRA PRICE.

28. No allowance in measure of depth of pavement will be made on account of any material which may be driven into the roadbed by rolling. The pavement, when completed, must conform to the grade and cross-section, and be satisfactory to the Engineer, whose decision shall be final.

29. No extra work will be paid for unless the price has been agreed between the contracting parties, including the State Commissioner of Public Roads, and indorsed upon the agreement, witnessed by the Engineer.

30. When extra depth of pavement is required, it must be obtained by making the pavement thinner on the more solid portions of the road. Changes in depth to be made only upon the written order of Engineer and State Commissioner of Public Roads, and as located by them.

31. All clay or gravel for shouldering and all extra hauling to be at the contractor's expense.

BIDS.

32. Bids will only be received under these specifications for the road complete. The prices per yard for excavating and macadam are intended for the use of the Engineer in making monthly estimate of work done to the Board of Freeholders. No bids will be received in which all of the following items are not filled out:

(1) Price per cubic yard for earth and shale excavations, without classification, as per cross-sections throughout the length and width of the road.

(2) Price per cubic yard for rock excavations, without classification, as per cross-sections throughout the length and width of the road.

(3) Price per square yard for ——— inch telford macadam road complete.

(4) Price per lineal foot for under-drains, furnishing all labor and material.

(5) Price (lump) for the whole road complete, according to above specifications, and plans prepared by the Engineer.

ESTIMATE OF QUANTITIES.

33. (1) Excavations, earth, ——— cubic yards.
(2) Excavations, rock, ——— cubic yards.
(3) ——— inch telford macadam, ——— square yards.
(4) Under-drains, ——— lineal feet.

34. These quantities are the result of careful calculation, but are to be considered as approximate. The county will not be responsible for any excess in above quantities, should any occur. The contractor is expected to satisfy himself as to the nature, character and quantity of the labor and material required by a personal examination of the work contemplated.

35. Bids shall be accompanied by approved bond, to insure the execution of the agreement, to the amount of at least one thousand ($1,000) dollars.

LIABILITIES OF CONTRACTOR.

36. He shall keep up sufficient guards by day and night to prevent accidents from travel, and will be liable for any damage which may arise by his neglect to do so, or from any omission on his part.

37. He shall keep the road sprinkled until the final certificate of completion by the Engineer is given.

38. He is to commence and prosecute the work upon the road at such points as may be directed by the Engineer and Supervisor, within ——— days from and after the signing of the contract, and shall continue work thereon until completion, except as herein provided.

39. He further agrees to complete the same on or before the ——— day of ———, A. D. ———. Twenty dollars for each day that the work shall remain uncompleted after the time allowed by contract

may be deducted from any moneys due contractor as liquidated damages. A bonus or premium of $1 per month will be paid the contractor for each month the road is completed before the time specified in the contract, except only to the provisions herein contained, unless otherwise agreed upon by the Board of Freeholders, on certificate of the Engineer recommending the extension of the time-limit of completion.

40. The contractor shall keep the finished roadway and earthwork in repair for the space of one year from the date of its completion and acceptance, and shall be liable for wear and tear caused by ordinary travel, and as much longer as for any period or periods during said year it shall be out of proper condition; and if during that time the roadway or any part of the work shall, in the judgment of the Engineer and Board of Freeholders, require repairing, and they shall duly notify the contractor to make repairs as required, and if the contractor shall refuse or neglect to do so, to the satisfaction of the said Engineer and Board of Freeholders, within five days from the date of service of notice, then said Engineer and Board of Freeholders shall have the right to have the work done properly by other parties and pay the expense for the same out of the five per cent. retained.

41. The contractor will be required to preserve all stakes and benchmarks made and established on the line of the work, until duly authorized by the Engineer to remove the same.

42. The contractor shall not disturb the position of title-stones (the corners to properties adjacent to road); where they appear he will either lift or lower them so that their tops may conform with the finished surface of the stone construction under the personal supervision of the Engineer.

43. The contractor must also preserve the roadway on which he is working from needless obstruction, and where necessary will construct safe and commodious crossings, to be maintained in good order, and to afford all proper and reasonable means for the accommodation of the public.

ENGINEER.

44. The Engineer is to be selected or appointed by the Freeholders and paid by them. He is to furnish all surveys, profiles, plans, specifications and quantities of all kinds before specifications are

signed, and in such a clear manner that lump bids can be made upon the work. He is to place stakes at small intervals on opposite sides of the road, marked for the finished grade, so that by line and rule the depth of pavement can be easily and correctly determined. He is also to furnish estimates of quantities of work done before partial payments are made, the quantity of road laid to be determined by surface measurement, and should any difference arise between the contracting parties as to their meanings, his decisions on these matters are to be final and conclusive. The work is to be done according to his direction, and if any material is brought upon the road not approved by him, it is to be removed at the expense of the contractor.

RIGHT TO BUILD BRIDGES, CULVERTS, ETC., AND SUSPENSION OF WORK.

45. The right of the county to build bridges, culverts, or lay pipes or other appurtenances in connection therewith, in said road, during the progress of the work, is expressly reserved, as well as suspending the work, or any part thereof, during the construction of the same for the purpose above stated, without further compensation to the contractor for such suspension than an extension of time for completing the work as much as it may have been delayed by such suspension.

STOPPING WORK ON ACCOUNT OF WEATHER.

46. The Supervisor, in his discretion, may stop any portion of the work if, in his judgment, the weather is such as to prevent the same being done properly. No allowance of any kind will be made for such stoppage, except an extension of the time for the completion of the work as herein provided for.

ABANDONMENT OF CONTRACT.

47. If at any time the work under contract should be abandoned, or if at any time the Supervisor or Engineer should judge and so certify in writing that said work or any part thereof is unnecessarily delayed, or that the contractor is wilfully violating any of the conditions or covenants of this contract, or is executing the same in bad

faith, the Board shall thereupon notify the said contractor to discontinue all work under this contract, and may employ other parties to complete the work in such manner as they may decide, and use such material as they may find upon the line of said work, and to procure other material for its completion, and charge the expense of the said labor and material to the contractor, to be deducted from any moneys due him under contract, and in case such expenses shall exceed the sum which would have been payable under contract, if the same had been completed by said contractor, he or his bondsmen shall pay the amount of the excess to the Board of Freeholders, on notice from the Engineer.

SUPERVISOR.

48. Nothing in these specifications, relating to the duties of the Engineer, shall be taken or construed to, in any manner, conflict with the duties of the Supervisor in the performance of his duties, as specifically set forth in the act entitled "An act to provide for the more permanent improvement of the public roads of this State," approved March 22d, 1895, and the supplements thereto, but they shall co-operate as far as practicable. The contractor shall employ competent men to do the work, and, whenever the Supervisor shall inform him in writing that any man on the work is unfitted for the place, or is working contrary to the provisions of the specifications or the instructions of the Engineer, he shall thereupon be discharged.

INSPECTION.

49. All directions and determinations, necessary to give due and full effect of any of the provisions of these specifications, shall be given by the Engineer and Supervisor.

50. All material and workmanship of any kind shall be subject at all times to the inspection of the Engineer and Supervisor. Whenever unfaithful and imperfect work is discovered it shall be repaired or replaced by the contractor, after due notification from the Engineer and Supervisor.

SUBLETTING OF CONTRACT.

51. The contractor shall not assign or sublet any portion of this contract without the consent of the Board of Freeholders and the State Commissioner of Public Roads.

PAYMENTS.

52. Monthly payments will be made by the Board of Freeholders to the contractor, if desired, for all completed work, upon presentation by him of the proper certificates of the Engineer and Supervisor, to the extent of eighty per cent. of the amount then due. Fifteen per cent. will be paid at the completion of the work. The balance (five per cent.) will be retained by the said Board of Freeholders to keep the roadway completed by the contractor in good repair in case said contractor fails to do so during the period of one year, after the expiration of which time and the final release of the contractor the said balance of five per cent., or such portion of it as has not been expended as aforesaid, will be paid over to the contractor.

BOND OF CONTRACTOR.

53. The contractor will be required to execute, within five days after giving of contract, a bond in such sum and with such securities, and not less than fifty per cent. of the cost of the road when completed, as shall be approved by the Board of Freeholders or its committee, conditioned for the faithful performance of the contract, and to indemnify and save harmless the parties of the said Board of Freeholders or its committee from all suits or actions of any name or description brought against them for or on account of any injuries or damages received or sustained by any party or parties, by or from the said contractor, his servants or agents, in the construction of said work, or by or in consequence of any negligence in guarding the same, or any improper material used in its construction, or by or on account of any act or omission of the contractor or his agents, and for the faithful performance of the contract by the contractor, and the said contractor hereby further agrees that so much of the money due him under and by virtue of this agreement, as shall be considered necessary by the Board of Freeholders or its committee, may be retained by the said Board of Freeholders or its committee until all such suits or claims for damages aforesaid shall have been settled, and evidence to that effect furnished to the satisfaction of the said Board of Freeholders or its committee.

CONTRACTOR TO INSURE PAYMENT FOR LABOR, MATERIAL, ETC., ON FINAL ESTIMATE.

54. The contractor must also furnish said Engineer and Supervisor with satisfactory evidence that all persons who did work or furnished material for this contract, or who have sustained damage or injury by reason of any act, omission or carelessness on his part or his agents, in the prosecution of the work, have been fully paid and secured; and shall also give notice to said Engineer and Supervisor within ten (10) days after the completion of the work, that any balance for such work or materials, or compensation for such damage still due, has been fully paid or released.

PERSONAL ATTENTION.

55. The contractor must give his personal attention to the work and not assign or sublet the same, but keep the same under his control.

_____ _____,
County Engineer.

_____ _____,
_____ _____,
_____ _____,
_____ _____,
_____ _____,
Road Committee.

Approved this _____, A. D. _____, by resolution of the Board of Chosen Freeholders.

_____ _____,
Director of Board Chosen Freeholders.

_____ _____,
Clerk of Board of Chosen Freeholders.

OFFICE STATE COMMISSIONER OF PUBLIC ROADS,
TRENTON, N. J.

I have this day carefully read and examined the foregoing specifications, and the same are hereby approved.

Any departure from these specifications which increases the cost of the road must have the written consent of the State Commissioner of Public Roads.

Given under my hand, this _____, A. D. _____.

_____ _____,
State Commissioner of Public Roads.

FORM OF SPECIFICATIONS FOR GRAVEL ROAD UNDER THE STATE AID LAW.

Specifications for a gravel road in ——— county, New Jersey, known as ——— road, beginning at ———, in the ———, extending to ———, a distance of ——— miles.

WORK TO BE PERFORMED.

1. The work to be performed will consist in carting all material, tools, machinery and labor necessary and proper for the efficient and proper grading and rolling of roadway, side ditches and side banks; laying, spreading and rolling of gravel, and leaving the roadway complete in every manner ready for immediate use.

PLANS, DRAWINGS.

2. The plans and cross-sections on file at the office of ——— show general location, profile, details and dimensions, and the work will be constructed in all respects according to the above-mentioned plans and cross-sections which form part of these specifications.

3. Any variation of location, profile, size and dimension from that shown on the plans as may be required by the exigencies of construction will in all cases be determined by the Engineer; but the contractor shall not on any pretense, save that of the written order of the contracting parties, including the State Commissioner of Public Roads, deviate from the intent of the plans or specifications.

4. On all drawings, figured dimensions are to govern in cases of discrepancy between scale and figure.

GRADING.

5. Under this head will be included all excavation and embankment required for the formation of the highway; cutting all ditches or drains about or contiguous to the road; removing all fences, walls, buildings, trees and poles; the excavation and embankment necessary for reconstructing cross or branch roads in cases where they are destroyed or interfered with in the formation of the roadway, and all other excavations and embankments connected with or incidental to the construction of the said road.

EXCAVATION.

6. The roadway to be prepared to receive a gravel bed ——— feet wide as shown on plans and to be excavated or built to a curvature to conform to the final surface of the road when finished; the grade from center to sides being as shown on plans, one inch fall to each foot.

7. The earth taken from any cut or ditch shall be deposited where Engineer may direct, either within or without the lines of the road, but no earth shall be removed from the line of the road without the order of the Engineer.

EMBANKMENT.

8. Material taken from the excavation, except when otherwise directed by the Engineer, shall be deposited in the embankment; the cost of removing such shall be included in the price paid for excavation. The price paid for excavation will be understood to cover and pay for the entire expense of its removal by any method whatever, including loading, transportation and deposit, in the manner prescribed in these specifications, in the places designated by the Engineer.

9. All material necessarily procured from without the road and deposited in the embankment will be paid for as excavation only.

10. The embankments will be formed in layers of such depth (generally six (6) inches), and the material deposited and distributed in such a manner as the Engineer may direct, the required allowance for settling being added.

SLOPES.

11. Slopes in both embankment and excavation shall be one and one-half ($1\frac{1}{2}$) horizontal to one (1) vertical, according to slope stakes, unless otherwise ordered.

ROADWAY.—SUB FOUNDATIONS.

12. When the excavations and embankments have been brought to a proper depth below the intended surface of the roadway, and the cross-section thereof conforming in every respect to the cross-section of the road when finished, the same shall be rolled with ——— roller until approved by the Engineer. If any depressions form under

such rolling, owing to improper material or vegetable matter, the same shall be removed and good earth substituted, and the whole re-rolled until thoroughly solid and to above-mentioned grade.

13. After the roadbed has been prepared and properly rolled, it shall not be disturbed by any carting or hauling upon the surface.

MATERIAL.

14. The Road Committee, in conjunction with the Engineer, subject to the approval of the Board, will locate all gravel to be used in the surfacing of this road, and the said Board will pay for all this gravel when the same is not donated, without any cost to contractor.

15. The contractor is to dig, cart, and place upon the road in accordance with the specifications, the gravel selected and to use no other gravel.

16. Should any objectionable material be used he is to remove the same at his own expense.

CONSTRUCTION.

17. The gravel is to be placed upon the road in layers, then to be thoroughly harrowed, mixed and rolled with roller approved by the Engineer, until it is thoroughly consolidated and firm. The whole of sufficient thickness that when it is thoroughly rolled and solidified the solid gravel will be ——— deep in the center and slope at a regular grade to ——— in depth at a distance of ——— feet on each side of the center line of road. Should any inequalities appear during the rolling, these are to be carefully filled with gravel so that the finished road will conform to the approved profile; no extra pay will be allowed for material required to fill these depressions.

18. The contractor is to be paid by the cubic yard for the compacted gravel that he puts on the road and to be measured on the road after it is thoroughly rolled, at the price named in the accepted bid, which is to include the loading, carting, spreading, mixing, harrowing and finishing the road and shaping the local earth shoulder.

SIDEWALK.

19. The contractor will also be required, when the engineer so directs, to grub and remove from sidewalk or strip of land ——— feet wide on outside of curblines, all material objectionable to the Engi-

neer, such as trees, stumps, roots, brush, &c., thereby completing the opening of the entire road to the width of ——— feet, which will be ——— feet on each side of the center line.

20. The grubbing and removing of such objectionable material to be done and measured only where the Engineer and Supervisor shall order. The same to be paid for by the acre for the land actually grubbed at prices named in the accepted bid.

CARTING GRAVEL.

21. The contractor will not be required to cart any gravel a greater distance than one-half mile without extra pay, for each extra half mile of carting or fraction thereof, at a price per cubic yard named in his accepted bid.

22. All gravel used for surfacing found within one-half mile of the place where it is to be used, whether on the line of the road or not, must be carted without extra pay.

23. On certain sections of the road when the gravel is found just where it is wanted, and does not require, in the judgment of the Engineer, to be loaded and carted, no allowance will be made for the same, other than the price per lineal foot accepted for "The Preparation of the Roadbed" and no other pay for the graveling, rolling or placing the same will be allowed.

24. If there are sections of this road which do not, in the judgment of the Engineer, require any "Preparation of the Roadbed," but do require a coat of gravel, this shall be applied when ordered by the Engineer in the manner already specified, and to a depth by him to be named, and measured when compact and paid for at same price per cubic yard as other gravel furnished under these specifications.

STRIPPING GRAVEL BEDS.

25. Some of the gravel beds are covered with objectionable surface material which must be first removed by the contractor, and deposited where the Engineer so directs, and to be paid for by the county at a price per cubic yard named in accepted bid for removing or stripping such objectionable material from top surface of gravel bed. No allowance will be made for removing stumps, trees, brush or roots from gravel pit.

SHOULDERING.

26. A shoulder of firm earth or gravel is to be left or made on each side, extending at the same grade and curvature of road to side ditches or gutters. This shoulder is to be thoroughly rolled for its entire width on each side of the gravel bed.

OPEN DITCHES.

27. When necessary, the side ditches or gutters are to be excavated as per stakes furnished by Engineer, to give an easy flow of water, so that no water shall be left standing on the road or in the ditches, for all of which no extra payment shall be made.

UNDER-DRAINS.

28. Under-drains, if found necessary, shall be constructed by the contractor (at prices named in bids) of good four (4) inch sole tile, laid upon a board of not less than one (1) inch in thickness and six (6) inches in width, whenever and wherever the Engineer shall decide; top of tile to be at least thirty (30) inches deep, unless otherwise directed by the Engineer, the joints of the tile to be covered with salt hay or other suitable material, and trench filled with pervious earth.

EXTRA DEEP.

29. Should the committee so order, the contractor is to build in all other respects, as already specified, the gravel bed to a greater depth or thickness than that already named. The contractor is to do the same at a price named per square yard for each extra inch in depth.

NO EXTRA PRICE.

30. No allowance in measure of depth of pavement will be made on account of any material which may be driven into the roadbed by rolling. The pavement, when completed, must conform to the grade and cross-section, and be satisfactory to the Engineer, whose decision shall be final.

31. No extra work will be paid for unless the price has been agreed upon between the contracting parties, including the State Commissioner of Public Roads, and indorsed upon the agreement, witnessed by the Engineer.

32. When extra depth of pavement is required, it must be obtained by making the pavement thinner on the more solid portions of the road. Changes in depth to be made only upon the written order of Engineer and State Commissioner of Public Roads, and as located by them.

33. All clay or gravel for shouldering and all extra hauling to be at the contractor's expense.

BIDS.

34. Bids will be received under these specifications as follows:

(1) Price per lineal foot for the preparation of roadbed.

(2) Price per acre for grubbing and removing objectionable matter from sidewalks.

(3) Price per lineal foot for completed tile drain.

(4) Price per cubic yard for excavating open ditches.

(5) Price per cubic yard for excavations on an average in excess of 12″ in one continuous cut in preparation of roadbed.

(6) Price per cubic yard for compacted gravel, ——— wide as specified.

(7) Price per square yard for each ordered inch in depth in excess of thickness named.

(8) Price per cubic yard for carting gravel more than one-half mile and each additional half mile or fraction thereof.

(9) Price per cubic yard for stripping or removing earth from top of gravel bed.

(10) Price (lump) for the whole road complete according to specifications—plans prepared by the Engineer.

ESTIMATES OF QUANTITIES.

35. (1) Number of lineal feet in preparation of roadbed.

(2) Number of acres that require grubbing.

(3) Number of lineal feet of tile drain.

(4) Number of cubic yards to be excavated from open ditches.

(5) Number of cubic yards in excess of twelve inches.

(6) Number of cubic yards of compacted gravel.
(7) Number of miles for carting in excess of one-half mile.
(8) Number of cubic yards of stripping on gravel-bed.
(9) ——— miles completed.
(10) Gravel road at ——— per mile.
(11) Total, ———.

36. These quantities are the result of careful calculation, but are to be considered as approximate. The county will not be responsible for any excess in above quantities, should any occur. The contractor is expected to satisfy himself as to the nature, character and quantity of the labor and material required by a personal examination of the work contemplated.

37. Bids shall be accompanied by approved bond, to insure the execution of the agreement, to the amount of at least one thousand ($1,000) dollars.

LIABILITIES OF CONTRACTOR.

38. He shall keep up sufficient guards by day and night to prevent accidents from travel, and will be liable for any damage which may arise by his neglect to do so, or from any omission on his part.

39. He shall keep the road sprinkled until the final certificate of completion by the Engineer is given.

40. He is to commence and prosecute the work upon the road at such points as may be directed by the Engineer and Supervisor, within ——— days from and after the signing of the contract, and shall continue work thereon until completion, except as herein provided.

41. He further agrees to complete the same on or before the ——— day of ———, A. D. ———. Twenty dollars for each day that the work shall remain uncompleted after the time allowed by contract may be deducted from any moneys due contractor, as liquidated damages. A bonus or premium of $1 per month will be paid the contractor for each month the road is completed before the time specified in the contract, except only to the provisions herein contained, unless otherwise agreed upon by the Board of Freeholders, on certificate of the Engineer recommending the extension of the time-limit of completion.

42. The contractor shall keep the finished roadway and earthwork

in repair for the space of one year from the date of its completion and acceptance, and shall be liable for wear and tear caused by ordinary travel, and as much longer as for any period or periods during said year it shall be out of proper condition; and if during that time the roadway or any part of the work shall, in the judgment of the Engineer and Board of Freeholders, require repairing, and they shall duly notify the contractor to make repairs as required, and if the contractor shall refuse or neglect to do so, to the satisfaction of the said Engineer and Board of Freeholders, within five days from the date of service of notice, then said Engineer and Board of Freeholders shall have the right to have the work done properly by other parties and pay the expense for the same out of the five per cent. retained.

43. The contractor will be required to preserve all stakes and bench-marks made and established on the line of the work, until duly authorized by the Engineer to remove the same.

44. The contractor shall not disturb the position of title-stones (the corners to properties adjacent to road); where they appear he will either lift or lower them so that their tops may conform with the finished surface of the gravel construction under the personal supervision of the Engineer.

45. The contractor must also preserve the roadway on which he is working from needless obstruction, and, where necessary, will construct safe and commodious crossings, to be maintained in good order, and to afford all proper and reasonable means for the accommodation of the public.

ENGINEER.

46. The Engineer is to be selected or appointed by the Freeholders and paid by them. He is to furnish all surveys, profiles, plans, specifications and quantities of all kinds before specifications are signed, and in such a clear manner that lump bids can be made upon the work. He is to place stakes at small intervals on opposite sides of the road, marked for the finished grade, so that by line and rule the depth of the pavement can be easily and correctly determined. He is also to furnish estimates of quantities of work done before partial payments are made, the quantity of road laid to be determined by surface measurement, and should any difference arise between the contracting parties as to their meanings, his decisions on

these matters are to be final and conclusive. The work is to be done according to his direction, and if any material is brought upon the road not approved by him, it is to be removed at the expense of the contractor.

RIGHT TO BUILD BRIDGES, CULVERTS, ETC., AND SUSPENSION OF WORK.

47. The right of the county to build bridges, culverts, or lay pipes or other appurtenances in connection therewith, in said road, during the progress of the work, is expressly reserved, as well as suspending the work, or any part thereof, during the construction of the same for the purpose above stated, without further compensation to the contractor for such suspension than an extension of time for completing the work as much as it may have been delayed by such suspension.

STOPPING WORK ON ACCOUNT OF WEATHER.

48. The Supervisor, in his discretion, may stop any portion of the work if, in his judgment, the weather is such as to prevent the same being done properly. No allowance of any kind will be made for such stoppage, except an extension of the time for the completion of the work, as herein provided for.

ABANDONMENT OF CONTRACT.

49. If at any time the work under contract should be abandoned, or if at any time the Supervisor or Engineer should judge and so certify in writing that said work or any part thereof is unnecessarily delayed, or that the contractor is wilfully violating any of the conditions or covenants of this contract, or is executing the same in bad faith, the Board shall thereupon notify the said contractor to discontinue all work under this contract, and may employ other parties to complete the work in such manner as they may decide, and use such material as they may find upon the line of said work, and to procure other material for its completion, and charge the expense of the said labor and material to the contractor, to be deducted from any moneys due him under contract, and in case such expenses shall exceed the sum which would have been payable under contract, if the same had

been completed by said contractor, he or his bondsmen shall pay the amount of the excess to the Board of Freeholders, on notice from the Engineer.

SUPERVISOR.

50. Nothing in these specifications, relating to the duties of the Engineer, shall be taken or construed to, in any manner, conflict with the duties of the Supervisor in the performance of his duties, as specifically set forth in the act entitled "An act to provide for the more permanent improvement of the public roads of this State," approved March 22d, 1895, and the supplements thereto, but they shall co-operate as far as practicable. The contractor shall employ competent men to do the work, and, whenever the Supervisor shall inform him in writing that any man on the work is unfitted for the place, or is working contrary to the provisions of the specifications or the instructions of the Engineer, he shall thereupon be discharged.

INSPECTION.

51. All directions and determinations, necessary to give due and full effect to any of the provisions of these specifications, shall be given by the Engineer and Supervisor.

52. All material and workmanship of any kind shall be subject at all times to the inspection of the Engineer and Supervisor. Whenever unfaithful and imperfect work is discovered it shall be repaired or replaced by the contractor, after due notification from the Engineer and Supervisor.

SUBLETTING OF CONTRACT.

53. The contractor shall not assign or sublet any portion of this contract without the consent of the Board of Freeholders and the State Commissioner of Public Roads.

PAYMENTS.

54. Monthly payments will be made by the Board of Freeholders to the contractor, if desired, for all completed work, upon presentation by him of the proper certificates of the Engineer and Supervisor, to

the extent of eighty per cent. of the amount then due. Fifteen per cent. will be paid at the completion of the work. The balance (five per cent.) will be retained by the said Board of Freeholders to keep the roadway completed by the contractor in good repair in case said contractor fails to do so during the period of one year, after the expiration of which time and the final release of the contractor the said balance of five per cent., or such portion of it as has not been expended as aforesaid, will be paid over to the contractor.

BOND OF CONTRACTOR.

55. The contractor will be required to execute, within five days after giving of contract, a bond in such sum and with such securities, and not less than fifty per cent. of the cost of the road when completed, as shall be approved by the Board of Freeholders or its committee, conditioned for the faithful performance of the contract, and to indemnify and save harmless the parties of the said Board of Freeholders or its committee from all suits or actions of any name or description brought against them for or on account of any injuries or damages received or sustained by any party or parties, by or from the said contractor, his servants or agents, in the construction of said work, or by or in consequence of any negligence in guarding the same, or any improper material used in its construction, or by or on account of any act or omission of the contractor or his agents, and for the faithful performance of the contract by the contractor, and the said contractor hereby further agrees that so much of the money due him under and by virtue of this agreement, as shall be considered necessary by the Board of Freeholders or its committee, may be retained by the said Board of Freeholders or its committee until all such suits or claims for damages aforesaid shall have been settled, and evidence to that effect furnished to the satisfaction of the said Board of Freeholders or its committee.

CONTRACTOR TO INSURE PAYMENT FOR LABOR, MATERIAL, ETC., ON FINAL ESTIMATE.

56. The contractor must also furnish said Engineer and Supervisor with satisfactory evidence that all persons who did work or furnished material for this contract, or who have sustained damage or injury by

reason of any act, omission or carelessness on his part or his agents, in the prosecution of the work, have been fully paid and secured; and shall also give notice to said Engineer and Supervisor within ten (10) days after the completion of the work, that any balance for such work or materials, or compensation for such damage still due, has been fully paid or released.

PERSONAL ATTENTION.

57. The contractor must give his personal attention to the work and not assign or sublet the same, but keep the same under his control.

———— ————,
County Engineer.

———— ————,
———— ————,
———— ————,
———— ————,
———— ————,
Road Committee.

Approved this ————, A. D. ————, by resolution of the Board of Chosen Freeholders.

———— ————,
Director Board of Chosen Freeholders.

———— ————,
Clerk of Board of Chosen Freeholders.

OFFICE STATE COMMISSIONER PUBLIC ROADS,
TRENTON, N. J.

I have this day carefully read and examined the foregoing specifications, and the same are hereby approved.

Any departure from these specifications which increases the cost of the road must have the written consent of the State Commissioner of Public Roads.

Given under my hand, this ————, A. D. ————.

———— ————,
State Commissioner of Public Roads.

APPENDIX B.

Following is the text of the State Aid Road law, with its amendments:

CHAPTER CCXXIII.

An Act to provide for the permanent improvement of public roads of this state.

Board of freeholders may cause road to be improved.

1. BE IT ENACTED *by the Senate and General Assembly of the State of New Jersey*, That whenever the board of chosen freeholders of any county in this state shall, by resolution, have declared their intention to cause any particular road, or section thereof, within such county, to be improved under the provisions of this act, such board shall cause all necessary surveys to be made and specifications to be prepared; the specifications shall require the construction of a macadamized road, or a telford or other stone road, or a road constructed of gravel, oyster shells or other good materials, in such manner that the same, of whatever materials constructed, will, with reasonable repairs thereto, at all seasons of the year, be firm, smooth and convenient for travel; shall be so prepared as to call for bids from which an approximate estimate of the cost can be ascertained, and shall state the amount of security that will be required of the bidder; after said specifications shall have been prepared they shall be submitted to the board of chosen freeholders for their approval or rejection; and if such board shall approve them, they shall then be submitted to the state commissioner of public roads for his approval or rejection; it shall be the duty of the commissioner of public roads, before approving the specifications for any road so submitted to him, to ascertain, by personal examination or otherwise, the natural

What specifications require.

How prepared.

Freeholders to reject or approve.

Commissioner to examine road and approve specifications.

character of the soil upon which such road is proposed to be constructed, and all other facts that he may deem important, and if, after examination of the specifications and facts so ascertained, he shall be of the opinion that the specifications provide for the construction of a road that will, with reasonable repairs thereto, be firm, smooth and convenient for travel at all seasons of the year, and if he shall also be of the opinion that one-third of the cost of constructing the road or section of road to which such specifications relate, together with one-third of the cost of constructing all other roads and sections of roads in this state under specifications previously approved by him, will not in any one year exceed the sum of one hundred thousand dollars, then he shall approve the specifications, but otherwise he shall reject them; *provided, however*, that he shall, in his discretion, have the power to withhold his approval of any specifications, to the end that the estimated aggregate amount of contracts made in any one year shall not exceed the sum of three hundred thousand dollars, and also to the end that the amounts paid out of the state treasury under the provisions of this act shall in each year be distributed amongst the several counties of the state in such manner as to the said state commissioner of public roads shall seem fair and equitable, and any specifications, the approval of which is withheld as aforesaid, may, if otherwise satisfactory to the said state commissioner of public roads, be approved by him in any year subsequent to the one in which the same may be presented for approval as aforesaid; if the board of chosen freeholders and the state commissioner of public roads shall both approve such specifications, it shall then be the duty of the director of the board of chosen freeholders to advertise in at least two daily newspapers, printed and circulating in the county, for the period of two weeks, or in at least two weekly newspapers, printed and circulating therein, for at least four weeks, for bids to do the work according to the specifications prepared; such advertisements shall state where bidders may find the specifications, and shall name a time and place where the board of chosen freeholders, or a committee of five members thereof, of whom the director

Cost of all roads not to exceed 33⅓ per cent.

May withhold his approval.

Distribute among the counties.

When approved, freeholders must advertise for bids.

Committee to receive bids.

shall be one, will meet to receive bids; every such bid shall be accompanied with the bidder's bond in the sum of one thousand dollars, with security satisfactory to the board, conditioned that if the contract shall be awarded to him he will, when required by the board, execute an agreement in writing to perform the work according to the specifications; no bids shall be received by the board or any member thereof, or by said committee or any member thereof, except at a meeting of said board or a committee, of which notice shall be given as aforesaid, and all bids then received shall be immediately publicly read; if the bids shall be received by a committee of the board they shall be reported to the board at the next meeting thereof, with the recommendations of the committee; the board may reject all bids if, in their opinion, good cause exist therefor, but otherwise they shall award the contract to the lowest bidder who shall give satisfactory evidence of his ability to perform the contract; *provided, however*, that the estimated amount of contracts awarded in any one year by any board of chosen freeholders, together with the estimated cost of repairs of roads already constructed, shall not exceed one-fourth of one per centum of the ratables of the county as reported to the state comptroller for the last preceding year; *and provided further*, that in every contract made as aforesaid it shall be specified that at least five per centum of the contract price shall not be paid to the contractor within the period of one year after the work specified to be done by such contract shall have been fully performed and accepted; the bidder to whom the contract may be awarded shall, in addition to executing the agreement to perform the work according to the specifications, also execute to the board of chosen freeholders a bond conditioned for the faithful performance of the contract, in the sum specified in the advertisement for bids, and with such sureties as the board may approve; the contract shall, on behalf of the board of chosen freeholders, be executed by the director thereof, and, when executed by the bidder and said director, a copy of the contract and specifications, with the estimated cost of the work, shall be forthwith filed with the state commissioner of public roads.

Bidders must give bond.

Bids, how received.

Limit of county expenditures.

Five per centum to be retained by county.

Contractors must give bond.

Copy of contract and specifications filed with state commissioner.

Commissioner must appoint supervisor.

2. *And be it enacted*, That after a copy of the contracts and specifications shall have been filed with the state commissioner of public roads as aforesaid, the said state commissioner of public roads shall, as soon as practicable, appoint a supervisor of the construction of the work under such contract, who shall receive for his services under this act three dollars per day, to be paid out of the county treasury; if the work for which such contract shall be made shall have been petitioned for, pursuant to the provisions of the eighth section of this act, then, if the petitioners therefor, or any of them, shall in writing nominate to the said state commissioner of public roads one or more persons for the position of such supervisor, it shall be the duty of said state commissioner of public roads, if only one nomination be made, to appoint as such supervisor the person so nominated, and, if more than one nomination be made, to appoint as such supervisor one of the persons so nominated, and if no such nomination be made, the said state commissioner of public roads shall then appoint as such supervisor any person whom he may consider competent for such position; the said state commissioner may, however, at any time summarily discharge any supervisor who, in the judgment of the state commissioner, is incompetent or who neglects his duty, and, in such case, shall appoint a new supervisor to take the place of the one so discharged; the supervisor shall supervise all work done under the contract, shall give his whole time thereto, shall require the provisions of the contract to be strictly adhered to by the contractor, and, in any case where the contract provides for partial payments during the progress of the work, he shall also, as each payment becomes due and before payment shall be made, present to the board his certificate, and also the certificate of the surveyor or engineer, if any there be, stating as near as may be the total amount of work done, and that such work has been done in all respects as required by the contract; and the board shall thereupon direct payment to be made by the county collector; *provided*, that no partial payment made during the progress of the work shall exceed eighty per centum of the estimated value of the work done; the

Property-owners nominate supervisor.

Commissioner may remove supervisor.

Supervisor must give his full time to the work.

Supervisor must certify payments.

board shall have power to borrow on temporary loans on the credit of the county such sums of money for the purpose of carrying on such work as may from time to time become necessary; and when the work shall have been fully completed, and the terms and conditions of the contract shall have been fully complied with, and such facts shall have been certified to the board to their satisfaction by the supervisor and the surveyor or engineer, if any there be, payment in full shall be made, less the amount required to be withheld for the period of at least one year, as in the next preceding section specified.

Freeholders may borrow money temporarily.

3. *And be it enacted*, That when the work under any contract shall have been fully completed, it shall be the duty of the supervisor to prepare a detailed and itemized statement in duplicate of the cost of the improvement, one copy whereof shall be filed with the board of chosen freeholders and one with the state commissioner of public roads.

Supervisor to prepare final certificate.

4. *And be it enacted*, That one-third of the cost of all roads constructed in this state under this act shall be paid for out of the state treasury; *provided*, that the amount so paid shall not in any one year exceed the sum of one hundred thousand dollars; if one-third of such cost shall appear by the statements filed in any one year with the state commissioner of public roads to exceed the said sum of one hundred thousand dollars, then, and in such event, the said sum of one hundred thousand dollars shall be apportioned by the governor and the state commissioner of public roads amongst the counties of the state in proportion to the cost of roads constructed therein for such year, as shown by the statements of costs filed in the office of the state commissioner of public roads; the governor and said state commissioner of public roads shall, between December fifteenth and thirty-first in each year, certify to the state comptroller the amount to be paid to each county for such year, and the state comptroller shall thereupon draw his warrants in favor of the respective county collectors for the sums certified as aforesaid upon the state treasurer, who shall pay the same out of any moneys in the state treasury not otherwise appropriated.

State to pay one-third cost.

Total state appropriation.

Allotment to be made before December 31st.

Comptroller to draw warrants.

Board of freeholders to certify cost to assessors.

5. *And be it enacted*, That on or before September first in each and every year it shall be the duty of the board of chosen freeholders to certify to the county board of assessors, either in the annual tax budget or separately, two-thirds of the estimated cost of all work for which contracts shall have been awarded under this act during such year; and the county board of assessors shall include the sum so certified in the county taxes assessed for such year, and the same shall be assessed, collected and paid over to the county in the same manner and within the same time that other county taxes are assessed, collected and paid over; if a deficiency shall exist in consequence of the cost exceeding the estimate, or in consequence of the receipt of less than one-third of the cost from the state treasury, the board of chosen freeholders shall have authority to borrow on temporary loans to the amount of such deficiency until the next annual taxes shall be assessed, collected and paid over to the county; and if there be a surplus, in consequence of the cost being less than the estimate, such surplus shall be retained and used in the construction of other roads under this act, or in repairs to roads constructed under this act.

Deficiency, how met.

Two-thirds less one-tenth.

6. *And be it enacted*, That instead of certifying to the county board of assessors two-thirds of the estimated cost of all work for which contracts shall have been awarded under this act in any one year as required by the fifth section of this act, or two-thirds of said estimated cost less one-tenth of said estimated cost as required by the eighth section of this act, the said board of chosen freeholders may, if a resolution to such effect shall be adopted by a vote of at least two-thirds of all its members, borrow such sum or sums of money as may be necessary for the payment of such proportion of said estimated cost by the sale of the bonds of such county, issued in the name of the board of chosen freeholders thereof, and in such sums as the said board may deem proper; said bonds shall bear interest at a rate not exceeding five per centum per annum, shall be sold at not less than their par value, shall not exceed in the aggregate the proportion of the estimated cost of such road as hereinabove mentioned, shall be so divided that one-tenth of the amount

Bonds, how sold.

of the proportion of said estimated cost shall fall due in one year from their date, and one-tenth of the proportion of said estimated cost in each successive year thereafter for the period of ten years after their date, and shall be either coupon or registered bonds, as the board of chosen freeholders may determine; the principal and interest thereof shall be made payable at the office of the county collector of such county; said bonds shall be signed by the director of said board and the county collector, and shall be sealed with the seal of the county, and the county collector shall keep a record thereof; it shall be the duty of the board of chosen freeholders each year to place in the tax levy for such county in each year, so long as said bonds shall run, a sufficient sum to pay the interest accruing thereon for said year and the principal of the bonds that shall mature in said year.

When to mature.

Record to be kept.

7. *And be it enacted*, That any road constructed under the provisions of this act, except within the limits of any city, shall forever thereafter be a county road, and the duty of keeping the same in repair, except within the limits of any city, shall devolve upon the board of chosen freeholders and the county supervisor hereinafter mentioned, and all other powers and duties respecting such roads, except within the limits of any city, shall be imposed upon and vested in the said board of chosen freeholders to the exclusion of all township, borough or other municipal officers excepting city officers; after the first road shall have been constructed under this act in any county, it shall be the duty of the board of chosen freeholders thereof to appoint a county supervisor of roads who shall hold his office for three years and until his successor is appointed, shall give bond to the board of chosen freeholders in the sum of one thousand dollars conditioned for the faithful performance of the duties of his office with such sureties as the board may approve, and shall receive such salary or allowance as the board may fix; the board of chosen freeholders shall provide all moneys necessary to keep in a proper state of repair the roads constructed under this act, except within the limits of any city, and may, if there be no moneys on hand that can be lawfully used for such repairs, borrow therefor on temporary

County road, township rights acquired.

County supervisor, when appointed.

Compensation to be fixed.

Duties of.

County to borrow by temporary loans.

loans until the next annual taxes shall have been assessed, collected and paid over to the county; it shall be the duty of the supervisor to report to the board of chosen freeholders, or to the road committee thereof, all repairs he may think necessary or proper to be made to such county roads,

Money, how expended.

and, under the direction and control of said board of chosen freeholders or its road committee, to expend the moneys raised for such repairs in such manner and upon such portions of the roads as will tend to keep them in the best possible state of repair; no part of said moneys shall be paid into the hands of the supervisor, but all expenses of repairs shall be paid by the county collector on the orders of the board of chosen freeholders, granted only on the presentation of bills verified by affidavit, as now required by law in the case of other claims against the county; if the board of chosen freeholders shall neglect or refuse to make appropriations sufficient to keep any such road as aforesaid in good repair, any citizen of the county may apply to the supreme court for a writ of mandamus to compel said board to make an appropriation as aforesaid; and when any such application is made, the court, upon a rule to show cause or otherwise, in such manner as the court shall prescribe, shall ascertain and determine whether such road as aforesaid is in a proper state of repair, and may also, in its discretion, allow to the attorney of the applicant a reasonable counsel fee to be paid by the county; in case the board of chosen freeholders shall not have on hand sufficient moneys out of which to make the appropriation commanded to be made by any writ of mandamus granted as aforesaid, they shall borrow such sum or sums as may be necessary therefor on temporary loans on the credit of the county, and shall require the amount so borrowed to be raised by taxation with the next assessment of county taxes; it shall be the duty of the authorities of any city within which any portion of road may be constructed under the provisions of this act to keep the portion thereof within such city in repair forever after such construction, and such city shall have the same power, authority and jurisdiction over such portion of such road, and shall have imposed upon it the same duties as were

County collector to make all payments.

Neglect to repair.

Freeholders to be mandamused.

Portion of road within city limits to be kept in repair by the city.

imposed upon and vested in it with respect to such portion of such road before its improvement under the provisions of this act.

Petition, how signed.

8. *And be it enacted*, That whenever there shall be presented to the board of chosen freeholders of any county a petition signed by the owners of at least two-thirds, either in lineal feet or in area, of the lands and real estate fronting or bordering on any public road or section of road in such county, taking in said estimate of area all the lands of every such owner which are assessed for taxes in said county and which lie together in any farm, tract or lot of which a part has a frontage on said road or section of road, praying the board to cause such road or section to be improved under this act, and setting forth that they are willing that the peculiar benefits conferred on the lands fronting or bordering on said road or section shall be assessed thereon in proportion to the benefits conferred to an amount not exceeding ten per centum of the entire cost of the improvement, it shall be the duty of the board to cause such improvement to be made; *provided*, that the road or section desired to be so improved shall be at least one mile in length, or, if it be less than one mile in length, shall be an extension of or connection with some other permanently improved or paved road or street; *and provided, further*, that the estimated cost of all improvements made under this act, together with the estimated cost of repairs of roads already constructed in any county in any one year shall not exceed one-fourth of one per centum of the ratables of such county for the last preceding year; *and provided, further*, that where more roads are applied for than can be constructed under this act in any one year, the said boards of chosen freeholders shall have the power and authority to select from the roads petitioned for the ones first to be constructed, having regard to the most important roads and the distribution of the benefits of this act to all parts of their counties; it shall not be necessary for the board in any such case to declare by resolution their intention to cause such improvement to be made, but they shall forthwith cause all necessary surveys of such road or section to be made, and specifications to be prepared for a

Lineal feet or area.

Length of road.

If less than one mile.

Estimated cost not to exceed one-fourth of one per centum of ratables.

Board of freeholders to select road under certain circumstances.

Must cause surveys to be made and specifications prepared.

Stone or other good material to be used.

macadamized road, or a telford or other stone road, or a road constructed of gravel, oyster shells or other good material, in such manner that the same, of whatever materials constructed, will, with reasonable repairs thereto, at all seasons of the year, be firm, smooth and convenient for travel; the proceedings shall thereafter be the same as is hereinbefore required in cases where such intention has been declared; if the specifications shall not be approved by the board or by the state commissioner of public roads, or if all the bids for the work shall be rejected, it shall be the duty of the board to cause other specifications to be prepared, or re-advertisements for bids to be made, as often as may be necessary and until a contract shall be awarded, to the end that the improvement prayed for may be completed with reasonable speed; *provided, however*, that no re-advertisement need be made where the lowest bid submitted shows that the improvement prayed for cannot be made within the limit of expenditure in this section above mentioned; in every case where a contract shall be awarded after the presentation of such petition as aforesaid, the board of chosen freeholders, instead of certifying to the county board of assessors two-thirds of the estimated cost of the work as prescribed by the fifth section of this act, shall, unless they determine to issue bonds in the manner prescribed by the sixth section of this act, which they are hereby authorized to do, certify two-thirds of said estimated cost less one-tenth of said estimated cost, which sum the county board of assessors shall include in their assessments of county taxes.

When specifications are not approved or bids rejected.

Other specifications to be made.

No re-advertisement necessary.

After contract awarded, board to certify two-thirds estimated cost, less one-tenth, to assessors.

Commissioners to estimate benefits, how appointed.

9. *And be it enacted*, That when the improvement prayed for as aforesaid shall have been completed and the statement of the cost thereof filed with the board of chosen freeholders, as prescribed by the third section of this act, said board shall apply to the circuit court of the county for the appointment of commissioners to estimate and assess the peculiar benefits conferred by such improvement upon the lands and real estate fronting or bordering on the road or section thereof improved, of the time and place of which application notice shall be given by ten days' publication in two daily newspapers printed and circulating in the county, or

To give notice of appointment of.

by two weeks' publication in two weekly newspapers printed and circulating therein, at which time and place, or at such other time and place as the court shall designate, said court shall, without unnecessary delay, appoint three commissioners, who shall be disinterested freeholders and residents of the county in which the application is made, to estimate and assess the benefits aforesaid; the said court shall have power to remove any commissioner and appoint another in his place and also to fill any vacancy that may occur in the office of any commissioner from any cause; said commissioners shall each receive three dollars per day, to be paid by the county collector.

Court to appoint and remove commissioners.

Compensation of.

10. *And be it enacted*, That said commissioners, before entering upon the duties required of them by this act, shall take and prescribe before some person duly authorized to administer the same an oath or affirmation that they will make all assessments and estimates required of them fairly, legally and equitably according to the best of their skill and understanding. which oath or affirmation shall be attached to the report that they are hereinafter required to make.

Oath of commissioners.

11. *And be it enacted*, That the said commissioners, having thus qualified, shall give such notice as the court may direct of the time and place when and where they will hear any persons in interest who may present themselves to be heard, and at such time and place and at such other times and places to which they may adjourn for that purpose the said commissioners shall attend, and shall give a public hearing to those persons in interest who may desire to be heard; the said commissioners shall have power to examine witnesses under oath or affirmation, to be administered by any one of them, and to enter upon and view the lands and real estate fronting or bordering on the road or section thereof improved, and to adjourn from time to time in their discretion, or as directed by said court; they shall use diligent efforts to ascertain the names of the owners of the lands fronting or bordering on the road or section thereof improved, and shall state the same in the report hereinafter mentioned; but the failure to ascertain the name of any owner, or to state the same correctly, or the omission of any

Commissioners to give public hearing of time of meeting.

such name from the report, shall not invalidate said assessment nor be a bar to the collection of the same.

Commissioners to report in writing.

12. *And be it enacted*, That after having given opportunity as aforesaid for a public hearing of the persons in interest, and having viewed the lands fronting or bordering on the road or section thereof improved as aforesaid, the said commissioners shall make a report in writing of their estimates and assessments to the said court, accompanied by a map prepared by the engineer in charge of the construction of the road, showing the several tracts or parcels of lands and real estate fronting or bordering on said road or section thereof; the said report shall state the cost of the whole work, which shall be furnished to the commissioners by the board of chosen freeholders from the report of the supervisor of construction filed with said board under the requirements of the third section of this act, and shall give the names, so far as ascertained, of the owners of the tracts or parcels of lands and real estate fronting or bordering on said road or section thereof, the city, township, borough or other municipality in which each tract or parcel of land is situate, and the amount of the assessment upon the owner or owners of each of said tracts or parcels of land and real estate for the said benefits; which several assessments shall be in proportion, as near as may be, to the peculiar benefits deemed to have been conferred by said improvement upon the respective tracts of land and real estate aforesaid; if any tract of land shall be located in more than one city, township, borough or other municipality, it shall be stated in said report as being in the city, township, borough or other municipality in which there is the greatest frontage by lineal feet on the road or section thereof improved; in no case shall any tract or parcel of land and real estate, or any owner thereof, be assessed beyond the amount of benefit actually derived from said improvement, nor shall the aggregate amount of assessments imposed upon the tracts or parcels of land fronting or bordering on such road or section thereof exceed ten per centum of the total cost of the improvement.

Map made by engineer in charge of the road.

Names of property-owners required.

Location of tracts of land.

13. *And be it enacted*, That upon the coming in of any such report signed by the said commissioners, or any two of them, said court shall cause such notice to be given as it shall deem proper of the time and place of hearing any objections that may be made to such assessment, and after hearing any matter that may be alleged against the same the said court, either by rule or order, shall confirm the said report, or shall refer the same to the same commissioners for revision and correction, or to new commissioners to be appointed by the said court forthwith to reconsider the subject-matter thereof, and the said commissioners to whom such report shall be so referred by the court shall return the same corrected and revised, or a new report to be made by them in the premises, to the said court without unnecessary delay, and the same, being so returned, shall be confirmed, or again referred by the said court in the manner aforesaid, as right and justice shall require, and so, from time to time, until a report shall be made or returned in the premises which said court shall confirm; such report, when so confirmed, shall be final and conclusive, as well upon the said boards of chosen freeholders and the cities, townships, boroughs or other municipalities in which said lands may be situate, as upon the owners of any lands and real estate affected thereby, and the court shall require the same to be forthwith filed with the county clerk, and certified copies thereof and of the accompanying map, and of the rule or order confirming the report, to be promptly delivered to the county collector, one for said county collector and for each city, township, borough or other municipality in which the assessed lands may lie; the county collector shall retain one of the said copies for his own use, and shall forthwith give one to the collector or receiver of taxes in each of the cities, townships, boroughs, and other municipalities in which the assessed lands may lie; each city, township, borough or other municipality whose collector or receiver of taxes shall receive such certified copy shall, by its proper disbursing officer, within six months after the date of the said order of confirmation, pay the amount of assessments appearing by said report to have been assessed upon the lands situate in such city, township,

Court to give notice of hearing.

Court may order new report.

When report is confirmed shall be final and conclusive.

File with county clerk.

Copies to county collector and townships, &c.

Township to collect in six months.

borough or other municipality, who shall receive for his services three per centum of the money so collected, to be paid by the county.

No certiorari allowed.

14. *And be it enacted*, That no certiorari shall be allowed by any court to review any of the proceedings in relation to such improvement, nor in any way to affect any assessment made by such commissioners, after the lapse of thirty days from the making of the order of the court confirming such assessment; the court shall designate what notice, if any, shall be given by the publication or otherwise of the confirmation of the report of said commissioners.

Assessments to remain a lien on the property.

15. *And be it enacted*, That the assessments made by said commissioners shall be and remain a lien upon the lands assessed from the date of the confirmation of the report of assessments in the same manner and to the same extent that taxes are liens upon lots or tracts of lands situate in the city, township, borough or other municipality in which the assessed lands may be.

Collector to notify owners of lands.

16. *And be it enacted*, That the receiver or collector of said city, township, borough or other municipality shall, as soon as the said report is delivered to him, give to the owners of lots and tracts of lands appearing by said report to be assessed, such notice of the assessments and of the time within which the same are required to be paid as the court in its order of confirmation, hereinabove mentioned, shall prescribe; all such assessments shall become due and payable to such receiver or collector within six months from the date of the order of confirmation hereinabove mentioned.

Township, &c., to bring suits for collection of assessments.

17. *And be it enacted*, That if any assessment upon any lot or tract of land made under the provisions of this act shall not be paid within the time appointed in said notice, the township committee, common council or other governing body in the city, township, borough or other municipality within which such lot or tract of land shall be situate, or a majority of them, may, as they shall deem proper, either bring an action on contract in any court of competent jurisdiction, in the corporate name of such city, township, borough, or other municipality, against the owner or owners of such lot or tract of land for so much money laid out and

expended by them for the use of such owner or owners and declare generally, and give the special matter in evidence, and either party from any judgment rendered therein may have the same remedy by appeal or otherwise as if said parties were private individuals, or they may proceed to collect the said assessment by sale of the lot or tract of land whereon such assessment has been imposed, or may be a lien, in the same manner and to the same extent as lands are now sold for unpaid taxes in such city, township, borough or other municipality, and the purchaser or purchasers at any such sale or sales and his legal representatives, shall hold and enjoy such lot or tract of land, with the rents, issues and profits thereof, in the same manner and by the same title and tenure as purchasers at the sales of lots or tracts of land for unpaid taxes can now hold and enjoy the same in such city, township, borough or other municipality.

Either party may appeal.

Assessments to be a lien upon the lands and sold as lands are now sold for taxes.

18. *And be it enacted*, That if any property-owners or owner along any road in any county of this state which has not been improved, or is not undergoing improvement, under the previous sections of this act, shall desire any section of any road in such county to be improved, and are or is willing to contribute the whole expense of such improvement, the supervisor of roads of such county shall, upon the written request of such owners or owner, make a plan of such section of road so to be improved, in which shall be given the levels and distances, and also specifications, which shall state the materials that may be used, and the manner of using them; and a copy of such plan, specifications and of any bids to do such work shall then be submitted by such owners or owner to the board of chosen freeholders, and if such board shall approve them, it shall then be lawful for such owners or owner to accept any bid or bids so approved from among the bidders, and proceed to build such section of road according to such plan and specifications, and such owners or owner shall have control of the expenditure of the moneys used to make such improvement, subject to the approval and supervision of the supervisor of such county; and upon the completion of the improvement to the satisfaction of the said supervisor and said board of chosen freeholders, and upon

Property-owners may improve at their own expense.

Bids and specifications received.

Owners to disburse the money.

the submission to said board of receipts, showing full payment for materials furnished and work done under the plan and specifications, such section of road so improved shall thereafter be a county road; and the said supervisor shall be paid by the aforesaid owners or owner the sum of ten dollars for making the plan, the sum of five dollars for drawing the specifications, and the sum of five dollars for the supervision of the work, and, in case such supervisor is not a civil engineer and an actual survey is necessary, then such owners or owner, at their or his expense, shall procure a survey which shall be subject to the approval of such supervisor, which survey shall take the place of the plan before mentioned.

Shall be a county road.

Fees allowed.

General repealer.

19. *And be it enacted*, That the act entitled "An act to provide for the more permanent improvement of the public roads of this state," approved the fourteenth day of April, one thousand eight hundred and ninety-two, and all acts supplementary thereto and amendatory thereof, be and the same are hereby repealed; *provided, however*, that this section shall not cause any proceedings for the improvement of any public road or section thereof under the provisions of the act hereby repealed to abate, but such proceedings may be continued under the provisions of this act in the same manner as if they had been commenced hereunder.

Proviso.

20. *And be it enacted*, That this act shall take effect immediately.

Approved March 22d, 1895.

Destroying Power to Mandamus.

CHAPTER 168.

A Supplement to an act entitled "An act to provide for the permanent improvement of public roads in this state," approved March twenty-second, one thousand eight hundred and ninety-five.

BE IT ENACTED *by the Senate and General Assembly of the State of New Jersey:*

1. Whenever there shall be presented to the board of chosen freeholders of any county in this state any petition by

the owners of lands praying the said board to cause any road or section thereof to be improved under the provisions of the act to which this is a supplement, it shall be the duty of such board of chosen freeholders, if they are satisfied that all the provisions and conditions of said act have been met and complied with in and by such petitions, to consider and to determine by a vote of a majority of all the members constituting said board, whether the road or section mentioned in said petition is of sufficient general importance to warrant the expenditure of the county and state money for the improvement thereof; and said board of chosen freeholders is hereby authorized, by a vote of a majority of all the members constituting the said board, to grant the prayer of the said petition or to refuse the same if said board shall be of the opinion that the improvement is not of sufficient public importance or that the expense thereof will be an unnecessary public burden; *provided*, that this act shall in no way affect any proceeding heretofore taken to procure a mandamus in case of petition filed under said act.

2. All acts and parts of acts inconsistent with the provisions of this act be and the same are hereby repealed, and this act shall take effect immediately.

Approved April 14th, 1896.

Changing Location or Improving.

CHAPTER 75.

An Act to amend an act entitled "An act to provide for the permanent improvement of public roads in this state," approved March twenty-second, one thousand eight hundred and ninety-five.

BE IT ENACTED *by the Senate and General Assembly of the State of New Jersey:*

1. The eighteenth section of the said act shall be amended so as to read as follows:

18. That if any property-owners or owner along any road in any county of this state which has not been improved

or is not undergoing improvement under the previous sections of this act shall desire any section of any road in such county to be improved or to be changed in location and improved, and are or is willing to contribute the whole expense of such improvement, and provided every owner of land upon that part of the road proposed to be vacated under this act shall consent in writing to such vacation, the supervisor of roads of such county shall, upon the written request of such owners or owner, make a plan of such sections of roads so to be improved or changed in location and improved, in which will be given the levels and distances, and also specifications stating the materials that may be used and the manner of using them; and a copy of such a plan, location, change of location, specifications and of any bids to do such work shall then be submitted by such owners or owner to the board of chosen freeholders, and if such board shall approve them and any change of location which may be proposed, it shall then be lawful for such owners or owner to accept any bid or bids so approved from among the bidders, or at their own expense to proceed to build such section of road according to such plan, location and specifications, and such owners or owner shall have control of the expenditure of the moneys used to make such improvements, subject to the approval and supervision of the supervisor of such county; and upon the completion of the improvement to the satisfaction of the said supervisor and said board of chosen freeholders, and upon the submission to said board of receipts showing full payment for materials furnished and work done under the plan and specifications, such section of road so improved shall, if the board of chosen freeholders shall so declare, thereafter be a county road, but otherwise shall remain an ordinary public highway, and any and all portions of any road now existing which may have been rendered unnecessary or be superseded by the new road so constructed shall be vacated and abandoned as a public road without other action or proceedings than the approval of the board of chosen freeholders as hereinbefore provided; and the said supervisor shall be paid by the aforesaid owners or owner the sum of ten

dollars for making the plan, the sum of five dollars for drawing the specifications, and the sum of five dollars for the supervision of the work, and in case such supervisor is not a civil engineer and actual survey is necessary, then such owners or owner at their or his expense shall procure a survey which shall be subject to the approval of such supervisor, which survey shall take the place of the plan before mentioned, and shall include all the new roads proposed to be constructed and all the old roads proposed to be abandoned.

Approved March 23d, 1896.

Increased Power to Borrow.

An Amendment to an act entitled "A supplement to an act entitled 'An act to enable boards of chosen freeholders to acquire, improve and maintain public roads,'" approved March nineteenth, one thousand eight hundred and eighty-nine, which supplement was approved April ninth, one thousand eight hundred and ninety-two.

BE IT ENACTED *by the Senate and General Assembly of the State of New Jersey:*

1. The first section of an act entitled "A supplement to an act entitled 'An act to enable boards of chosen freeholders to acquire' improve and maintain public roads,'" approved March nineteenth, one thousand eight hundred and eighty-nine, which supplement was approved April ninth, one thousand eight hundred and ninety-two, be amended so as to read as follows: Section to be amended.

BE IT ENACTED *by the Senate and General Assembly of the State of New Jersey:*

1. In counties of the second class it shall be lawful to raise a sum not to exceed four hundred thousand dollars, for which bonds may be issued by the board of chosen freeholders of any such county, under the act to which this is a supplement or any supplement or amendment thereof; *provided, however,* that if work under said act and supplements Amount authorized to raise and bonds issued. Proviso.

or amendments has already been done to an amount exceeding said sum, bonds under said act and supplements may be issued to an amount sufficient to raise and pay for such work;

Proviso. *and provided also*, that no county road bonds shall be issued to such an amount as, in addition to existing debt, shall raise the debt of the county for all purposes above three per centum of the assessed value of the real estate therein; and in case any such bonds shall be issued in excess of the limit aforesaid, all such bonds so issued in excess shall be void in the hands of any person or party notwithstanding any recitals therein or any representations that may be made concerning the same; in case application has already been made to the circuit court and a certificate shall have been recorded and filed, as required by said act, such application need not be repeated in case of any subsequent issue of such bonds where the original certificate on file shows that the new issue of bonds will not exceed three per centum of the assessed value of the real estate in said county as limited by this act.

2. The second section of said act be amended so as to read as follows:

Board not to use money raised except to grade, &c. 2. In any county of the second class wherein the board of chosen freeholders thereof shall heretofore or may hereafter issue bonds under said act and supplements, that such board of such county shall not use any of the money so raised for any other purpose except to grade, macadamize or improve any road in any such county, under the provisions of the act to which this is a supplement and the several supplements and amendments thereof;

Proviso. *provided*, nothing herein shall prohibit the doing of the necessary repair of any road heretofore graded, macadamized or improved by any such board or that may be hereafter graded, macadamized or improved under said act and supplements.

3. All acts and parts of acts inconsistent herewith be and the same are, so far only as they conflict herewith, repealed, and that this act shall take effect immediately.

Approved March 24th, 1897.

CHAPTER 100.

A Supplement to an act entitled "An act to provide for the permanent improvement of public roads in this state," approved March twenty-second, one thousand eight hundred and ninety-five.

BE IT ENACTED *by the Senate and General Assembly of the State of New Jersey:*

Boundary road or street may be improved.

1. Any road or street, or section of road or street, which constitutes the boundary line between two counties, may be acquired, improved and maintained in manner provided for in the act to which this act is a supplement.

Freeholders of adjoining counties may meet to consider improvements.

2. It shall be lawful for the board of chosen freeholders representing adjoining counties which are divided by any road, street or section of road or street, to jointly meet at such time and in such place, in either county, as they may agree upon, to consider and determine the question of acquiring, improving and maintaining said boundary road or street, or section of road or street, according to the provisions of said act, to the best advantage of the public and the owners of property adjacent thereto; and to that end the said joint board are hereby authorized to prepare maps, plans and specifications, subject to the approval of the commissioner of public roads, for said improvement, which they shall deem necessary and proper for said purposes; the said joint board shall have power to employ a competent engineer or surveyor and such other assistance as they may deem necessary, and upon the completion of said maps, plans and specifications, duplicate copies thereof shall be filed in the office of the clerk of each of the counties affected thereby, and in the office of the commissioner of public roads.

Prepare maps.

Employ engineer.

Make contract.

3. The said joint board may adopt a resolution directing the improvement, as provided for in said act, to be made, and thereupon said joint board shall have full power and authority to enter into contracts with responsible persons for doing the work and furnishing the necessary materials therefor; they shall advertise for proposals in at least two newspapers published in each county, for at least three

weeks, and their contracts shall be awarded to and made with the lowest responsible bidder who will comply with the requirements of the joint board and will give ample security for doing the work and performing the contract, but said joint board shall be under no obligation to accept the lowest bid, in which case all other bids will be thrown out and new proposals advertised for in the manner hereinbefore provided.

Payment.

4. The said joint board shall, on the certificate of the engineer and surveyor, and on such other evidence as they may require as to the work done and materials used and furnished for said improvement, order payments to be made to the contractor or contractors in the manner provided in said act.

Expenses equally divided.

5. All costs and expenses incurred in the proceedings hereinbefore authorized shall be borne and paid by each county in equal proportion, and the said joint board shall, after the completion of the contract and acceptance of the improvement, divide the road into two equal sections, and

Maintenance.

shall designate the section which each county shall maintain and keep in repair, and therefore each of said counties shall maintain and keep in repair the sections of the road so assigned to it.

Method of transacting business by joint board.

6. Said joint board may choose a chairman and secretary and such other officers, and may make such rules for government as shall be deemed advisable; the said joint board shall have power to meet and adjourn from time to time, and as often as in their judgment it shall be deemed necessary to fully carry into effect the provisions of this act; the votes of a majority of the members of the board of each county voting separately shall be necessary to decide any question, order, motion or resolution which may come before

Compensation.

the said joint board; the secretary of said joint board and the engineer and supervisor appointed shall receive such compensation for their services as the said joint board shall, as aforesaid, determine to be just and proper; the members of said board shall be entitled to the same compensation as is allowed to them as members of the board of chosen freeholders, and shall comply with the provisions of

and receive the benefits from the act to which this is a supplement, as far as the same is consistent and practical.

7. This act shall take effect immediately.

Approved March 23d, 1898.

An Act to provide for the acquirement of turnpike roads for free public use.

BE IT ENACTED *by the Senate and General Assembly of the State of New Jersey:*

1. Whenever there shall be presented to the state commissioner of public roads a petition signed by the owners of at least two-thirds of the land and real estate fronting or bordering on any turnpike road, praying that said road may be acquired for free public use, and setting forth that they are willing that the peculiar benefits conferred on the lands fronting or bordering on said road shall be assessed thereon to an amount not exceeding ten per centum of the entire cost of the said road, then the governor shall appoint five commissioners from the county or counties through which the said road runs; the said commissioners, when appointed, shall take an oath or affirmation faithfully and fairly to perform their duties, and shall thereupon proceed to estimate and determine the fair and just value of the said road, having given ten days' notice of the time and place when and where they will meet to hear any representation in behalf of the said corporation or of the board or boards of chosen freeholders of the various counties through which the said turnpike runs, or of the applying freeholders in the said matter; said notice shall be served upon the president or other chief officer of said corporation, upon the director or clerk of the said board or boards of chosen freeholders, and shall be published at least one week prior to the time of meeting in one newspaper published in each county through which said turnpike runs; such meeting shall be adjourned from time to time at the discretion of the said commissioners; when the said commissioners shall have arrived at a price or value of the said turnpike road satisfactory to them-

Turnpike roads may be acquired for public use.

Commissioners appointed.

Hearings had.

Notice given.

selves they shall report the same to the road commissioner, who may thereupon ratify the same and report it to the board or boards of chosen freeholders of the counties through which the said road runs, who may thereupon purchase the same; and they are hereby empowered to make temporary loans upon the credit of the said county or counties for the acquirement of the said roads as aforesaid.

Temporary loans may be made.

Cost.

2. One-third of the cost of all roads so acquired under this act shall be paid for out of the state road appropriation; *provided*, that the amount so paid shall not in any one year exceed the amount of twenty thousand dollars; if one-third of such cost shall exceed the sum of twenty thousand dollars, the said sum of twenty thousand dollars shall be apportioned by the governor and the state commissioner of public roads among the counties of this state in proportion to the cost of the roads acquired by them for such year as shown by the statement of cost filed in the office of the state commissioner of public roads; the governor and the said commissioner shall, between December fifteenth and thirty-first in each year, certify to the state comptroller the amount to be paid to each county for such year, and the state comptroller shall thereupon draw his warrants in favor of the respective county collectors for the sums certified to as aforesaid upon the state treasurer, who shall pay the same out of any moneys in the state treasury not otherwise appropriated;

Proviso.

Proviso.

provided further, that the cost of all turnpike roads acquired under this act in any county in any one year, together with all roads built or repaired, shall not exceed one-fourth of one per centum of the ratables of such county for the last preceding year.

Assessors to include certain amount in county taxes.

3. On or before August first in each and every year it shall be the duty of the board of chosen freeholders to certify to the county board of assessors, either in the annual tax budget or separately, the two-thirds of the cost of all turnpike roads acquired so as aforesaid during the year, and the county board of assessors shall include the sum so certified in the county taxes assessed for such year, and the same shall be assessed, collected and paid over to the county in the same manner and within the same time that other county

taxes are assessed, collected and paid over; if a deficiency shall exist in consequence of the receipt of less than one-third of the cost from the state treasury, the board of chosen freeholders shall have authority to borrow on temporary loans to the amount of such deficiency until the next annual taxes shall be assessed, collected and paid over to the county. Deficiency.

4. If the said road shall run through more than one county the petition to the state commissioner of public roads shall be signed by at least two-thirds of the owners of the land and real estate bordering on said road in each county before the governor shall be required to appoint the five commissioners mentioned in the first section of this act; and each of the said counties shall bear the expenses of the acquirement of the said road in proportion to the length thereof within the said counties, and all proceedings after the appointment of the said five commissioners that may be required by virtue of this act shall be had separately and independently in each of the said counties. If the road is in more than one county.

5. Any road so acquired shall forever thereafter be a free county road, and the duty of keeping the same in good order and repair shall devolve upon the county officers in like manner as heretofore provided for free stone roads. Road to be free and maintained by county.

6. When the said turnpike roads shall have been so acquired the board of chosen freeholders shall apply to the circuit court of the county for the appointment of commissioners to estimate and assess the peculiar benefits conferred by such acquirement upon the lands and real estate bordering on the road so acquired, of the time and place of which application notices shall be given by ten days' publication in two daily newspapers printed and circulating within the said counties, then by two weeks' publication in two weekly newspapers printed and circulating therein, at which time and place or at such other time and place as the court shall designate, shall without unnecessary delay, appoint three commissioners, who shall be freeholders and residents of the county in which the application is made, to assess the benefits aforesaid; the said court shall have power to remove any commissioner and appoint another in his place and also fill Benefits assessed by commissioners appointed by court.

any vacancy that may occur in the office of any commissioner at any time.

Method of assessing benefits.

7. The said commissioners shall then proceed in like manner as the commissioners appointed to assess the benefits conferred by the improvement of the public roads of this state under and by virtue of an act of the legislature entitled "An act to provide for the permanent improvement of the public roads of this state," approved March twenty-second, one thousand eight hundred and ninety-five, and the supplements thereto, and the report of the said commissioners when filed and approved shall be a lien upon the properties assessed in like manner, and the said assessment shall be collected in like manner as the assessment in the said act last before mentioned.

8. This act shall take effect immediately.

Approved May 11th, 1897.

Broad Tires.

CHAPTER 76.

An Act to amend an act entitled "An act to enable township committees to encourage the use of broad tires on wagons and carts by a rebatement of taxes."

1. BE IT ENACTED *by the Senate and General Assembly of the State of New Jersey*, That section one of an act entitled "An act to enable township committees to encourage the use of broad tires on wagons and carts by a rebatement of taxes," approved March sixteenth, one thousand eight hundred and ninety-three, which reads as follows:

"1. BE IT ENACTED *by the Senate and General Assembly of the State of New Jersey*, That township committees be and they are hereby authorized, when in their judgment it is for the public good, to pass an ordinance allowing a rebate of taxes for township or road purposes to all owners or possessors of wagons and carts used in said township for transportation of goods, wares, merchandise, produce, passengers, and for general farm, freight and express purposes, having

tires of not less than four inches in width; *provided*, the said rebate shall not exceed fifty cents for each wheel in use in any one year," be and the same is hereby amended so as to read as follows:

1. BE IT ENACTED *by the Senate and General Assembly of the State of New Jersey*, That township committees be and they are hereby authorized, when in their judgment it is for the public good, to pass an ordinance allowing a rebate of taxes for township or road purposes to all owners or possessors of wagons and carts used in said township for transportation of goods, wares, merchandise, produce, passengers, and for general farm, freight and express purposes, having tires of not less than four inches in width; *provided*, the said rebate shall not exceed one dollar for each wheel in use in any one year.

2. That this act shall take effect immediately.

Passed March 24th, 1896.

APPENDIX C.

NEW JERSEY.

1. All road taxes are to be paid in money.

2. The office of overseer of highway is abolished.

3. The roads of a township are placed under the management of the township committee, and money may be raised by township bonds for grading, macadamizing and improving the same; bonds to be authorized by vote at the annual town meeting.

4. Under the County act, the Board of Chosen Freeholders of any county may designate certain roads as county roads, and improve the same by the issue of county bonds; townships to pay one-third of the cost.

5. Under the State Aid law, whenever the owners of two-thirds of the lands fronting on any public road will undertake to pay one-tenth of the cost of improving such road, the Board of Chosen Freeholders may cause such improvements to be made, the State paying one-third of the cost up to, at present, the limit of $100,000 per year.

6. Under the act for the acquirement of turnpike roads for free public use, whenever the owners of two-thirds of the land fronting on any turnpike toll-road pray that said road may be acquired for free public use, and that they are willing to pay ten per cent. of the entire cost of such road, the Governor appoints five commissioners to estimate and determine the fair and just value of said road; after having arrived at such value, if the State Road Commissioner ratifies the same, the board may purchase, the State paying one-third of the cost and the county paying the balance, fifty-seven per cent.

Receiving many inquiries how to proceed to lay out roads, change location, &c., to save correspondence we give the following quotations from the statutes.

LAYING OUT ROADS BY FREEHOLDERS.

It shall be lawful for the Board of Chosen Freeholders of any of the several counties of this State, when said board deem it for the best interests of such county, to lay out, construct and maintain public roads extending through such county in any direction, to submit, by resolution, the question whether or not such public roads shall be laid out, to the electors of said county, at an election, to be held at the same time and place of holding the general election in and for said county for members of the General Assembly of this State, by the same officers, but in separate ballot-box, and if, at such election, a majority of the electors shall vote "against public road," nothing in this act shall apply or be effective in said county; but if a majority of the electors vote "in favor of public road," then the board shall proceed as directed by the act entitled "An act to authorize the board of chosen freeholders of any of the several counties of this state to lay out, open, construct, improve and maintain a public road therein," approved April 7th, 1888. P. L. 1888, p. 397.

FORM OF APPLICATION TO LAY OUT, VACATE OR ALTER PUBLIC ROADS. (Revised Statutes, page 2828–119, Sec. 1.)

That when ten or more persons, being freeholders, shall think a public road necessary, or any public road which hath been or shall be laid out unnecessary, or any alteration in such road necessary in any part of the county in which they reside, it shall be lawful for the said persons to make application in writing to the inferior court of common pleas of the said county, in open court, having given previous notice for at least ten days of such intended application, and also of the day on which such application is intended to be made, by advertisements under their hands, and set up at three of the most public places in the township in which the said road is proposed to be laid out, vacated or altered, and if there be more townships than one through which the said road may run, by advertisements to be set up at three of the most public places in each township; and the said court, when applied to as aforesaid, on due proof being made that the advertisements have been set up according to law, on which the judgment of the court shall be final and conclusive, are hereby authorized

and required to appoint six of the surveyors of the highways of the said county, ever having regard to the appointment of the surveyors of the highways of the township or townships where the said road shall be so applied for to be laid out, vacated or altered; *provided*, that no surveyor shall be appointed through whose land the road may run, or who for any other reason which the court in their discretion shall deem sufficient, think ought not to be appointed; and the said surveyors shall meet at such time and place as the said court shall direct, a copy of which appointment shall be served on each of the said surveyors at least six days prior to the time of their meeting; and two of the said applicants shall, at least twelve days prior to the said time, sign and set up advertisements at three of the most public places in the said township or townships, setting forth the time and place of the meeting of the surveyors agreeably to the directions of the court, and designating the points or places from and to which the said road is proposed to be laid out, vacated or altered. (See Secs. 138 and 168, *post.*)

138. Sec. 1. That whenever ten or more persons, being freeholders, shall think any alteration of any public road necessary in any part of the county wherein they reside, by having such road or a portion thereof vacated, and the same relaid or another road substituted therefor, they may make application in writing to the inferior court of common pleas of such county, or to one of the judges thereof, setting forth in writing the road or portion thereof as aforesaid which it is proposed to have vacated, describing the same by courses and distances and also describing the road as it is to be relaid, or the road which is to be substituted therefor, to which description there shall be attached a map showing the location of the road or portion of road to be vacated and the road as relaid, or the road which is to be substituted therefor; and if within ten days after such application shall have been made as aforesaid, or if at the time of making such application there shall be presented to said court or judge the consent in writing of the owners of all the lands intersected by such old road or portion thereof proposed to be vacated, and of all the property intersected by the road as proposed to be relaid, or by the road which it is proposed to substitute therefor, and also the written consent of the township committee of the township wherein such road or roads do lie, that said application shall be granted, then it shall be lawful for said court or judge to cause said application, with the accompanying

survey, map and return, and the written consents of the owners of lands as aforesaid, and of the township committee, to be filed with the clerk of the county, to be by him recorded in the book of roads for said county; and when said application and other papers shall have been so filed, such old road or portion thereof shall thereupon and thereby be deemed to be vacated, and the road as relaid, or the new road substituted therefor, shall thereupon and thereby be deemed and taken to be a public road.

168. Sec. 1. That whenever ten or more persons, being freeholders, shall think the vacation of a part of any public road necessary in any part of the county wherein they reside, they may make application in writing to the inferior court of common pleas of such county, or to one of the judges thereof, setting forth in writing the road or portion thereof which it is proposed to have vacated, deseribing the same by courses and distances, to which description there shall be attached a map showing the location of the road, or portion thereof to be vacated, and if within ten days after such application shall have been made as aforesaid, or if at the time of making such application, there shall be presented to said court or judge the consent in writing of the owners of all the lands by such old road or portion thereof proposed to be vacated, and also the written consent of the township committee of the township wherein such lands do lie, that such application shall be granted, then it shall be lawful for said court or judge to cause said application, with the accompanying survey, map and return, and the written consents of the owners of lands as aforesaid, and of the township committee, to be filed with the clerk of the county, to be by him recorded in the book of roads for said county, and when said application and papers have been so filed, such portion of such old road shall thereupon and thereby be deemed to be vacated; *provided*, that no portion of any old road proposed to be vacated under this act shall exceed one thousand yards in length.

APPENDIX D.

Number of tons of stone per mile required to build the following depths and widths.

For the information of intending road-builders, we have compiled the following tables, which approximate the number of tons of thoroughly-rolled stone necessary to construct each mile at the designated depths and widths.

The basis is 3,000 tons of loose stone or 3,500 tons of compressed stone for a road one mile long, sixteen feet wide and eight inches deep. A road eight inches deep, when finished, will have required at least ten inches of loose stone. It should be placed in two layers of five inches each, and each layer rolled down to four inches. Then the application of the three-quarter inch and screenings will bring the road to the prescribed depth; for other thickness the stone should be placed in proportion to the intended finished depths.

An observance of this rule will insure the contract thickness for the roadbed, and save the sometimes necessary expense of resurfacing before acceptance from the contractor.

A road	8	feet wide	and	4	inches	deep	will require.....	875	tons of	stone per mile.
"	8	"	"	6	"	"	.....	1,312½	"	" "
"	8	"	"	8	"	"	.....	1,750	"	" "
"	8	"	"	10	"	"	.....	2,187½	"	" "
"	8	"	"	12	"	"	.....	2,625	"	" "
"	9	"	"	4	"	"	.....	984⅜	"	" "
"	9	"	"	6	"	"	.....	1,476 9/16	"	" "
"	9	"	"	8	"	"	.....	1,968¾	"	" "
"	9	"	"	10	"	"	.....	2,460 15/16	"	" "
"	9	"	"	12	"	"	.....	2,953⅛	"	" "
"	10	"	"	4	"	"	.....	1,093¾	"	" "
"	10	"	"	6	"	"	.....	1,640⅝	"	" "
"	10	"	"	8	"	"	.....	2,187½	"	" "
"	10	"	"	10	"	"	.....	2,734⅜	"	" "
"	10	"	"	12	"	"	.....	3,281¼	"	" "

A road	11	feet wide	and	4	inches deep	will require.....	1,203⅛	tons of	stone per mile.
"	11	"	"	6	"	"	1,804 11/16	"	" "
"	11	"	"	8	"	"	2,406¼	"	" "
"	11	"	"	10	"	"	3,007 13/16	"	" "
"	11	"	"	12	"	"	3,609⅜	"	" "
"	12	"	"	4	"	"	1,312½	"	" "
"	12	"	"	6	"	"	1,968¾	"	" "
"	12	"	"	8	"	"	2,625	"	" "
"	12	"	"	10	"	"	3,281¼	"	" "
"	12	"	"	12	"	"	3,937½	"	" "
"	13	"	"	4	"	"	1,421⅞	"	" "
"	13	"	"	6	"	"	2,132 13/16	"	" "
"	13	"	"	8	"	"	2,843¾	"	" "
"	13	"	"	10	"	"	3,554 11/16	"	" "
"	13	"	"	12	"	"	4,265⅝	"	" "
"	14	"	"	4	"	"	1,531¼	"	" "
"	14	"	"	6	"	"	2,296⅞	"	" "
"	14	"	"	8	"	"	3,062½	"	" "
"	14	"	"	10	"	"	3,828⅛	"	" "
"	14	"	"	12	"	"	4,593¾	"	" "
"	15	"	"	4	"	"	1,640⅝	"	" "
"	15	"	"	6	"	"	2,460 15/16	"	" "
"	15	"	"	8	"	"	3,281¼	"	" "
"	15	"	"	10	"	"	4,101 9/16	"	" "
"	15	"	"	12	"	"	4,921⅞	"	" "
"	16	"	"	4	"	"	1,750	"	" "
"	16	"	"	6	"	"	2,625	"	" "
"	16	"	"	8	"	"	3,500	"	" "
"	16	"	"	10	"	"	4,375	"	" "
"	16	"	"	12	"	"	5,250	"	" "
"	17	"	"	4	"	"	1,859⅜	"	" "
"	17	"	"	6	"	"	2,789 1/16	"	" "
"	17	"	"	8	"	"	3,718¾	"	" "
"	17	"	"	10	"	"	4,648 7/16	"	" "
"	17	"	"	12	"	"	5,578⅛	"	" "
"	18	"	"	4	"	"	1,968¾	"	" "
"	18	"	"	6	"	"	2,953⅛	"	" "
"	18	"	"	8	"	"	3,937½	"	" "
"	18	"	"	10	"	"	4,921⅞	"	" "
"	18	"	"	12	"	"	5,906¼	"	" "

A road	19	feet	wide and	4	inches	deep will require.....	2,078⅓	tons of	stone per mile.
"	19	"	"	6	"	"	3,117 5/15	"	" "
"	19	"	"	8	"	"	4,156⅓	"	" "
"	19	"	"	10	"	"	5,195 5/15	"	" "
"	19	"	"	12	"	"	6,234⅔	"	" "
"	20	"	"	4	"	"	2,187½	"	" "
"	20	"	"	6	"	"	3,281¼	"	" "
"	20	"	"	8	"	"	4,375	"	" "
"	20	"	"	10	"	"	5,468¾	"	" "
"	20	"	"	12	"	"	6,562½	"	" "

TABLES.

As many persons interested in the construction of stone roads are asking questions about their cost, we inclose a table to show at a glance the number of square yards at different widths in a mile of road; also the cost at different widths and various prices per square yard. Any variations from these prices can be quickly ascertained, by adding, subtracting, multiplying and dividing, for a less or greater width. For example, a road eight feet wide has 4,693⅓ square yards in one mile. Nine feet wide would be obtained by adding one-eighth of that number of square yards; for seven feet wide you would subtract one-eighth of that number of square yards. For twice that number of feet you would multiply by two.

SQUARE YARDS IN ONE MILE OF

8	feet in width.....	4,693⅓	square yards.
10	"	5,866⅔	"
12	"	7,040	"
14	"	8,213⅓	"
16	"	9,386⅔	"
18	"	10,560	"

8	feet wide, or	4,693⅓	square yards, at	25c.	per yard.....		$1,173	33⅓
10	"	5,866⅔	"	25c.	"		1,466	66⅔
12	"	7,040	"	25c.	"		1,760	00
14	"	8,213⅓	"	25c.	"		2,053	33⅓
16	"	9,386⅔	"	25c.	"		2,346	66⅔
18	"	10,560	"	25c.	"		2,640	00
8	"	4,693⅓	"	30c.	"		$1,408	00
10	"	5,866⅔	"	30c.	"		1,760	00
12	"	7,040	"	30c.	"		2,112	00
14	"	8,213⅓	"	30c.	"		2,464	00
16	"	9,386⅔	"	30c.	"		2,816	00
18	"	10,560	"	30c.	"		3,168	00

8	feet wide, or	4,693⅓	square yards, at	35c.	per yard	.....	$1,642 66⅔
10	"	5,866⅔	"	35c.	"	.....	2,053 33⅓
12	"	7,040	"	35c.	"	.....	2,464 00
14	"	8,213⅓	"	35c.	"	.....	2,874 66⅔
16	"	9,386⅔	"	35c.	"	.....	3,285 33⅓
18	"	10,560	"	35c.	"	.....	3,696 00
8	"	4,693⅓	"	40c.	"	.....	$1,877 33⅓
10	"	5,866⅔	"	40c.	"	.....	2,346 66⅔
12	"	7,040	"	40c.	"	.....	2,816 00
14	"	8,213⅓	"	40c.	"	.....	3,285 33⅓
16	"	9,386⅔	"	40c.	"	.....	3,754 66⅔
18	"	10,560	"	40c.	"	.....	4,224 00
8	"	4,693⅓	"	45c.	"	.....	$2,112 00
10	"	5,866⅔	"	45c.	"	.....	2,640 00
12	"	7,040	"	45c.	"	.....	3,168 00
14	"	8,213⅓	"	45c.	"	.....	3,696 00
16	"	9,386⅔	"	45c.	"	.....	4,224 00
18	"	10,560	"	45c.	"	.....	4,752 00
8	"	4,693⅓	"	50c.	"	.....	$2,346 66⅔
10	"	5,866⅔	"	50c.	"	.....	2,933 33⅓
12	"	7,040	"	50c.	"	.....	3,520 00
14	"	8,213⅓	"	50c.	"	.....	4,106 66⅔
16	"	9,386⅔	"	50c.	"	.....	4,693 33⅓
18	"	10,560	"	50c.	"	.....	5,280 00
8	"	4,693⅓	"	55c.	"	.....	$2,581 33⅓
10	"	5,866⅔	"	55c.	"	.....	3,226 66⅔
12	"	7,040	"	55c.	"	.....	3,872 00
14	"	8,213⅓	"	55c.	"	.....	4,517 33⅓
16	"	9,386⅔	"	55c.	"	.....	5,162 66⅔
18	"	10,560	"	55c.	"	.....	5,808 00
8	"	4,693⅓	"	60c.	"	.....	$2,816 00
10	"	5,866⅔	"	60c.	"	.....	3,520 00
12	"	7,040	"	60c.	"	.....	4,224 00
14	"	8,213⅓	"	60c.	"	.....	4,928 00
16	"	9,386⅔	"	60c.	"	.....	5,632 00
18	"	10,560	"	60c.	"	.....	6,336 00
8	"	4,693⅓	"	65c.	"	.....	$3,050 66⅔
10	"	5,866⅔	"	65c.	"	.....	3,813 33⅓
12	"	7,040	"	65c.	"	.....	4,576 00
14	"	8,213⅓	"	65c.	"	.....	5,338 66⅔
16	"	9,386⅔	"	65c.	"	.....	6,101 33⅓
18	"	10,560	"	65c.	"	.....	6,864 00

8	feet wide, or	4,693⅓	square yards, at	70c.	per	yard.....	$3,285 33⅓
10	"	5,866⅔	"	70c.	"	.....	4,106 66⅔
12	"	7,040	"	70c.	"	.....	4,928 00
14	"	8,213⅓	"	70c.	"	.....	5,749 33⅓
16	"	9,386⅔	"	70c.	"	.....	6,570 66⅔
18	"	10,560	"	70c.	"	.....	7,392 00
8	"	4,693⅓	"	75c.	"	.....	$3,520 00
10	"	5,866⅔	"	75c.	"	.....	4,400 00
12	"	7,040	"	75c.	"	.....	5,280 00
14	"	8,213⅓	"	75c.	"	.....	6,160 00
16	"	9,386⅔	"	75c.	"	.....	7,040 00
18	"	10,560	"	75c	"	.....	7,920 00
8	"	4,693⅓	"	80c.	"	.....	$3,754 66⅔
10	"	5,866⅔	"	80c.	"	.....	4,693 33⅓
12	"	7,040	"	80c.	"	.....	5,632 00
14	"	8,213⅓	"	80c.	"	.....	6,570 66⅔
16	"	9,386⅔	"	80c.	"	.....	7,509 33⅓
18	"	10,560	"	80c.	"	.....	8,448 00
8	"	4,693⅓	"	85c.	"	.....	$3,989 33⅓
10	"	5,866⅔	"	85c.	"	.....	4,986 66⅔
12	"	7,040	"	85c.	"	.....	5,984 00
14	"	8,213⅓	"	85c.	"	.....	6,981 33⅓
16	"	9,386⅔	"	85c.	"	.....	7,978 66⅔
18	"	10,560	"	85c.	"	.....	8,976 00
8	"	4,693⅓	"	90c.	"	.....	$4,224 00
10	"	5,866⅔	"	90c.	"	.....	5,280 00
12	"	7,040	"	90c.	"	.....	6,336 00
14	"	8,213⅓	"	90c.	"	.....	7,392 00
16	"	9,386⅔	"	90c.	"	.....	8,448 00
18	"	10,560	"	90c.	"	.....	9,504 00
8	"	4,693⅓	"	95c.	"	.....	$4,458 66⅔
10	"	5,866⅔	"	95c.	"	.....	5,573 33⅓
12	"	7,040	"	95c.	"	.....	6,688 00
14	"	8,213⅓	"	95c.	"	.....	7,802 66⅔
16	"	9,386⅔	"	95c.	"	.....	8,917 33⅓
18	"	10,560	"	95c.	"	.....	10,032 00
8	"	4,693⅓	"	$1.00	"	.....	$4,693 33⅓
10	"	5,866⅔	"	1.00	"	.....	5,866 66⅔
12	"	7,040	"	1.00	"	.....	7,040 00
14	"	8,213⅓	"	1.00	"	.....	8,213 33⅓
16	"	9,386⅔	"	1.00	"	.....	9,386 66⅔
18	"	10,560	"	1.00	"	.....	10,560 00

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